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EDITORIAL

MILK AND INFECTION

ONE is only just beginning to realise what gaps there are in our knowledge of some of our most common every-day foods, and with no food is that more so than with milk. The subject of the bearing of the milk supply upon the health of the nation is one engaging the attention of many at the present moment in different countries. The great value of milk is its richness in different vitamins, the great danger in milk is its liability to be infected with the bacteria of bovine turberculosis which is capable of conveying disease to man. One of the best foods for man is raw milk provided it can be obtained clean and free from harmful bacteria but whilst the medical profession realise this they insist generally that it should be heat treated which not only destroys the harmful germs but also many useful ones which are present in the raw material.

The physiological value of milk is related to the pasture upon which the cows graze, young pasture being a rich source of vitamins, and vitamins are related in some mysterious way to the quantity of the sunshine that falls upon the living substance in which they occur. With us in Ceylon the sunshine is comparatively always present but not so in more northern and southern latitudes. Possibly connected in some measure with our bountiful sunshine has been in the past the absence of tuberculosis from among our milch cattle. Bovine Tuberculosis has so far been a comparatively rare occurrence in Ceylon and its reported

presence amongst a herd in the hill tracts cannot be considered other than as a misfortune. Modern veterinary science enables it to be ascertained whether a herd is free from the disease. An important Advisory Committee on Cattle Diseases has just reported in England that no milk should be sold that does not conform to a standard of cleanliness and that all milk sold should be designated as heat treated, (sterilised or pasteurised), or certified as derived from tubercle-free cows, or as uncertified but which is of the standard of cleanliness required The Committee concludes that forty per cent. of the cows in England are infected with tuberculosis to such an extent as to react to the tuberculin test. We are very much better off than that in Ceylon and provided simple precautions be taken as to a clean source of supply, milk here should be generally a perfectly safe food.

RUBBER

THE USE OF IMPROVED PLANTING MATERIAL—*(Contd.)*

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IV. SEEDLING SELECTION

In the foregoing pages we have already mentioned seedling selection where the work is started with seedlings from clonal seeds. For several years a good deal of attention has been paid to improvement of seedlings, and raising seedlings from artificially cross-fertilised or self-fecundated seeds. It struck me during my last trip to the East (end of 1933 to beginning of 1934) that the various experiment stations are now starting tapping experiments on plots of seedlings, obtained by artificial crosses. The results are so far promising and indicate that also in this direction great improvements can be reached.

I do not want to be misunderstood, whilst fully recognising the value of the work now in progress, and the possibilities it offers for further improvement, I do not think that at present we know enough of the seedlings and the methods to improve their yields; to yet recommend the giving up of the planting of clones. On the contrary, in my opinion the actual best and most certain planting materials are still buddings of the well-studied, highly productive clones on the market. But I would make it clear that it is quite possible that we shall come back in some years to seedling planting.

The yields of seedlings obtained by a controlled combination of mother and father, or by self-fecundation, indicate that we may reach averages of the level of clonal yields, but that generally speaking, the seedlings show a much wider variation, comprising always a certain percentage of plants without value, and on the other hand, also a certain percentage of plants surpassing the best clones in yield. Since Dr. Heusser in Sumatra started to work on seedlings his most valuable work has given us interesting data on this point. At the same time it showed that this work—castrating and isolating flowers and fecundating

them with pollen of another clone—is difficult and complicated, while it gives only a low percentage of success—if 5 per cent. of the flowers treated produce seeds this may be considered quite a high figure. While these experiments are valuable to teach us the worth of various clones (or mother trees) as seed or pollen parents, it seems improbable that we shall ever be able to produce such artificially pollinated seeds in commercial quantities for large field planting.

In the years before 1930 many fields had been laid out for the purpose of producing seeds. These were in isolated spots in the jungle or in the midst of coconut plantations. The object was generally to produce hybrid seeds combining desirable qualities from the parents, and to attain this the plantings consisted of mixed clones, the different clones often being planted in alternate rows. Now we find that most clones easily give seeds when planted in monoclonal blocks and are so limited to fecundation by their own kind that we think that this system loses its value. As we find now that by far the largest number of clones gives easily seeds when planted in monoclonal blocks and so limited to self-fecundation, we think this system loses its value. The difficulty with seeds from mixed clonal plantings is that one never knows which parents have furnished the pollen, and that the picking of the seeds if we want to use only seeds of a certain clone, becomes quite a task. If seeds from monoclonal plantings are used, no precautions are necessary to guarantee the purity of the seeds, except that the monoclonal planting should be inspected and, if rogues or impure clones occur, these should be cut out. But if this is done, we may simply collect all the seeds from the ground and have the certainty that they are all from the same origin, and that, if the seedlings raised from them show certain characters, they will always show these characters.

We have seen figures from fairly large plantings, where buddings and seedlings of a certain number of clones were compared, each set comprising several hundreds of trees, and we have been able to study the tapping results. The clones were the older Avros clones like 71, 163, and so on. Generally speaking the unselected seedlings gave a lower average than the unselected buddings, but, as might be expected, the range of variation for these last was much wider than for the seedlings. The result was that, when we compared the average yield for the 25 per cent. best seedlings with the average for the best 25 per cent. buddings, the seedlings gave more.

Is it possible to plant out seedlings and to retain only the 25 per cent. best ones ? Theoretically—yes. On the ground of interesting experiments on density of planting we have seen in Sumatra and with common experience in Indo-China, we are now in favour of starting our planting with a high density, for instance about 300 trees per acre, 10 by 15 feet will give us 290 trees per acre and seems suitable. As soon as the seedlings are developing into true trees, let us say after 3 years, we would submit them to an experimental tapping. Mr. Mann of the R.R.I. in Kuala Lumpur has shown, that when we tap the trees ten days and measure the yield for the last five days, we have a true measure for their productivity. We can rest them again for half a year and apply then a second tapping test. According to these two tests the poorest yielders can at this stage be removed, say 20 to 25 per cent. of the total number of trees. Repeating continuously the selective thinning-out during our further commercial tapping we can arrive at a final stand for the old rubber of say 70 trees per acre—25 per cent. of the original stand. I admit, that in thinning out we cannot go by yield alone, too large open spaces must be avoided, and so we will never succeed in having only our very best 25 per cent. of the trees, but still it seems possible to arrive at a selection that the trees kept correspond, let us say, to the 30 per cent. highest classes of the seedlings and in this case the average yield should be above that of a clonal planting treated the same way. From these considerations, we feel convinced, that by planting clonal seeds, choosing a very dense original stand and applying a regular selective thinning out from the early stage on, we may arrive at higher yielding fields than budded fields would give, however, the actual proof of this system in practice and on a scale sufficient to consider the results as reliable, has not yet been given.

There is still another method of bringing the observations mentioned above into practical application. It is now generally accepted that a high yielding tree is born a high yielder. So, when we have before us a nursery, we have a mixture of plants, some predestined to become high yielders and others of medium or poor yield. The question is, how we can find out the future high yielders.

Many people will remember that some years ago this fact was pointed out by Mr. Ashplant and that he based a method of selection on it, using as a criterion the latex vessel bore. When

I visited Southern India at the end of 1929 on various plantations fields had been laid out following Ashplant's system. They must be now tappable and it is to be hoped, that some figures on the tapping results will find their way into current literature. In my opinion Ashplant's system would have some effect, but it seemed difficult to apply it from the point of view of practical plantation practice, and he was handicapped with his experiments in another respect: he did not, so far as I know, use clonal seeds, which generally speaking present much greater possibilities than common seeds.

I have myself tried to devise a system of seedling selection based on the same fundamental observations, starting experiments on it in 1918-19. The idea was this—if a high yielding tree is born a high yielder and if so a seedling in the nursery is already predestined to become a high or a poor yielder, can we not find out which is which, by applying some system of tapping and retaining only the highest yielding seedlings ? To arrive at a practical method we have to find at first a tapping system for these young plants. Our system consists in pressing into the bark a set of V shaped knives fixed on a strip of metal (British patent 309·90f) judging afterwards the yielding capacity of the seedling by the stream of latex coming out of the 4 super—posed V cuts. We generally classify the plants then into 5 classes and we use only the best class for planting out, which for some clones may be 5 per cent.

We can apply this system not only with plants in nurseries but also with direct planting. In the last case we lay out our fields with 9 seedlings per planting hole, or, with planting trenches instead of holes, say for instance, 15 feet apart. In the trench we plant germinated seeds in double rows, one foot apart between the two rows and in the rows. Of course, clonal seeds, but the place where we started these experiments in Malaya, Carey Island, Port Swettenham, F.M.S. produces already large quantities of seeds of many clones. After a little over a year the nursery test tapping is applied and repeated once or twice; then the poor yielders are removed and in the rows plants kept at a distance of 9, 10, 11, or 12 feet. If a very high yielder is found, which by its place would have to go, it can still be transplanted to a vacancy. We have then an original planting of 10 by 15 feet, allowing us still several thinnings out on the same

principle, as described in the beginning. We have not yet definite results from plantings started in this way, but all indications are that they will be a success.

The system opens possibilities for other improvements. However we think instead of dwelling upon this we had better wait till we can mention some of the results, which we hope will be possible in a couple of years. An important point will be not only the system of improvement but also the choice of the clone from which the seeds are taken. Preliminary results indicate that the different clones may give quite different sets of seedlings in this respect. Another point is that from high yielding one year old plants we can make at once a few buddings and so progress also in the direction of vegetative multiplication with our planting material.

BOVINE TUBERCULOSIS IN CEYLON

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THE occurrence of a number of cases of Tuberculosis among up-country cattle during the past year has brought the disease into prominence.

Ceylon is remarkably free from this disease which is such a scourge of cattle in Europe and it is necessary that everything possible should be done to preserve the freedom which has been enjoyed in the past. To attain this end the co-operation of all owners of cattle is necessary.

Up to the present cases have been confined to cattle of European or Australian breed and the infection has undoubtedly been introduced by cattle imported into Ceylon from either Europe or Australia.

No cases have been met with in cattle of the native breed. This does not mean that local cattle are immune or resistant to the disease. In the past the view has often been expressed that the freedom of native cattle in Tropical countries must be due to a natural immunity or resistance. Evidence which has accumulated in recent years from other Tropical countries throws grave doubt on the correctness of this view. For example recent reports from Siam show that 14 per cent. of the local cattle are infected, in Fiji the disease has been found to be just as prevalent among cattle of Indian breed as among cattle of European breeds, and reports from various parts of Africa indicate that it is present in herds of cattle of local African breeds.

The probable explanation of the rarity of the disease in local cattle in Tropical countries in the past is that infection was not present in these countries but has been introduced by cattle from Europe and is only now beginning to spread to the local cattle.

The following are the important points with regard to this disease:—

Cause.—The disease is due to infection with the Bovine type of the Bacillus tuberculosis. This organism is very similar to the Human type but is not identical with it. The most

important difference between the two varieties of this bacillus is that the Human type is practically incapable of causing disease in cattle, on the other hand the Bovine type while of comparatively little importance as a cause of disease in adult human beings is a common cause of Tuberculosis affecting certain parts of the body in children in many parts of the world. The Bovine type of bacillus is responsible in Europe for a considerable proportion of cases of Tuberculosis in children, affecting bones and joints, the cervical lymphatic glands, the abdominal lymphatic glands and the meninges.

Tuberculosis of these organs in children in Ceylon is, I understand, of much less frequent occurrence than in Europe, a fact which is doubtless associated with the rarity of Bovine Tuberculosis among Ceylon cattle up to the present.

The Tubercle bacillus whether of the Bovine or Human type belongs to the class of acid-fast bacilli, a class of bacilli characterised by their comparatively high resistance, outside the animal body, to injurious agents such as heat, cold, desiccation, putrefaction and disinfectants. Direct sunlight however has a very destructive effect on them.

Method of infection.—The two common methods of infection are (a) through the respiratory tract by inhaling bacilli coughed up or otherwise discharged by an infected animal, (b) through the digestive tract by eating food contaminated with bacilli discharged by an infected animal.

Infection is therefore much more likely to take place when animals are housed especially when they are overcrowded and the cattle sheds are dark, ill-ventilated and dirty.

Many cattle sheds in up-country districts are badly lighted, badly ventilated, badly drained and often overcrowded. In many cases the cattle are confined to these sheds throughout their lives and are never permitted to take exercise in the open air. Should infection be introduced to such sheds the conditions are ideal for its rapid spread and there is every chance of all or a very high proportion of the cattle becoming infected within a short space of time. Apart from the fact that such sheds provide favourable conditions for the dissemination of the Tubercle bacilli, cattle kept under such conditions have their resistance to infection lowered and are less able to resist the invasion of their bodies by the bacilli. Fresh air and exposure to sunlight strengthen the natural defences of the body and enable an animal to throw off infection.

Nature of the disease in cattle.—In most cases Tuberculosis is of a chronic nature and progresses very slowly. It may be present in a dormant form for a very long time without causing any outward symptoms which would attract the attention of the owner. In many cattle it may never progress beyond this stage and such cattle will continue to all outward appearances in good health for long periods. The progress of the disease beyond this stage is facilitated by unfavourable conditions such as housing in dark, stuffy, insanitary sheds, inadequate feeding, the strain imposed by heavy milking and frequent calvings, advancing age or the presence of other debilitating diseases such as heavy worm infection, etc.

It is only in fairly advanced cases that outward symptoms are shown and these vary with the part of the body which is affected. Almost any organ of the body may be affected but the parts in which the disease is most frequently seen are as follows:

The lungs and other parts of the respiratory system. In such cases the commonest symptom is a chronic cough. The cough may not be very frequent or very loud but it is persistent and shows no tendency to clear up. The typical Tuberculosis cough is a short, dry, harsh cough which gives the impression that the cow is attempting to suppress it. It must not be confused with the longer, louder, softer cough commonly heard in healthy cattle from time to time especially when they have finished a heavy feed and their stomachs are distended.

If a cow suffering from a tuberculous cough is kept tied facing a clean wall, careful examination of the wall may show that small pieces of sputum are expelled during coughing and may be found adhering to the wall. Such pieces of sputum are yellowish in colour. They are not always present as most cows swallow the sputum which is brought up during coughing. Where present, however, they are a valuable help to diagnosis. As the disease progresses in the lungs there is usually loss of condition and finally emaciation.

Intestines.—When the intestines are affected there are no very obvious symptoms except in advanced cases when there is a persistent diarrhoea.

Lymphatic glands.—When any organ is affected the corresponding lymphatic glands become enlarged. The superficial lymphatic glands in some cases are enlarged and can be observed as swellings under the skin, such swellings are hard, painless

and tend to enlarge very slowly. They are most commonly seen near the throat at the angle of the jaw, in front of the shoulder, in front of the breast bone at the entrance to the chest, and in the flank. They vary in size usually not bigger than an orange but occasionally much bigger up to the size of half a coconut.

The Udder.—Tuberculosis of the udder is a very important condition from the point of view of human health as when the udder is affected the milk contains Tubercle bacilli in varying numbers. In the initial stages no marked change is produced and the milk is not altered in appearance. Later there is a gradual diffuse enlargement of the affected quarter, there is no acute painful swelling as occurs in ordinary Mastitis. One or more quarters of the udder may be affected, the right hind quarter being more commonly affected than the others. This condition is not very common, the percentage of cases in which the udder is affected being comparatively small.

Diagnosis.—This, save in advanced cases, is often difficult. Microscopical examination of specimens of such material as sputum, milk, discharge from the vagina, pus from enlarged glands, etc. will often enable a diagnosis to be made.

Fortunately in the Tuberculin test we have a very reliable method of determining whether the disease is present or not. The test, in competent hands, has a very high degree of accuracy and is free from danger to the cattle tested. It is in daily use throughout the world and has proved of the greatest service in campaigns directed towards the eradication of this disease. A slight drawback to the test is that it does not give any indication as to the extent of the disease or to what stage it has advanced. A cow affected to only a slight degree will react just as well as one extensively affected.

The test can be applied in various ways and is based on the fact that when Tuberculin, which may be defined as a sterile extract from a culture of the Tubercle bacillus, is injected into an animal, such animal if affected with Tuberculosis will react either by a rise of temperature or by a local swelling at the place where the Tuberculin is injected while a healthy animal will not react in any way. The test can only be applied by a Veterinary Surgeon, it cannot be done by the owner himself.

Danger to human health from milk of Tuberculous cattle.—Speaking generally it may be said that as a rule the milk does not contain Tubercle bacilli unless the udder is affected with Tuberculosis. Tubercle bacilli are however sometimes found in the milk of cows even when the udder is not affected. In such cases the cow is extensively diseased in other parts of the body and is eliminating bacilli in the sputum, dung, urine or discharge from the uterus. The outside of the udder becomes contaminated with these infected discharges and small quantities fall into the milk at the time of milking. It is therefore essential that such cows, that is cows affected with Tuberculosis of the udder or advanced Tuberculosis in other parts of the body should be removed at once from any dairy herd.

Excluding these cows there is the cow which is to all appearances in good health, showing no symptoms of disease, but which reacts to the Tuberculin test. Tubercle bacilli are not as a rule eliminated in the milk of such cows and they do not constitute a danger to human health. It is necessary, however, that both the cows themselves and the milk be examined at regular intervals so that any cows in which the disease has advanced may be detected at once and removed from the dairy.

Where any suspicion attaches to the milk the danger can be obviated by raising the milk to the boiling point before using it. This destroys the bacilli. Mere heating of the milk will not suffice. It must be brought to the boiling point.

Danger to human health from eating meat from Tuberculous cattle.—The danger from this source is not so great as from milk on account of the high temperature to which meat is raised during cooking.

Competent veterinary inspection in slaughter houses of all carcases is an efficient safeguard. The practice in European countries which is approved by all public health authorities is to condemn as unfit for human food the whole carcase of any animal which shows evidence of advanced Tuberculosis. Where the disease is not advanced but localised to one part, the affected and surrounding parts only are destroyed, the remainder of the carcase being passed as fit for human consumption.

STEPS TO BE TAKEN BY CATTLE OWNERS

(1) Report at once any cattle which are suspected to be affected either to the Government Agent, the Government Veterinary Surgeon or the local Headman.

(2) After reporting and pending examination by a Veterinary Officer keep the suspected animal isolated from the others.

(3) See that all cattle sheds are well lighted, well ventilated, clean and not overcrowded. Sunlight is an efficient disinfectant and cheap, full advantage should be taken of it.

(4) Be careful when purchasing new cattle. Make searching enquiries regarding the herd from which they came. If there is any doubt have new purchases isolated and tested by the Tuberculin test before allowing them to join the herd.

(5) The disease is scheduled under the Contagious Diseases (Animals) Ordinance (Ceylon). It is an offence to fail to report cases or to move a diseased or suspected animal off the premises or to allow it to come in contact with any other cattle.

THE RUBBER RESEARCH SCHEME, CEYLON

G. W. BRUCE FOOTE,

MANAGER, ELSTON ESTATE

[The following note was prepared by Mr. Bruce Foote for the meeting of the Central Board of Agriculture, but time not admitting its presentation is given here.]

I was for many years a member of the Executive Committee of the Old Research Scheme before the Reconstitution in 1930 and I have visited the Laboratories and Experiment Station at Nivitigalakele on many occasions, so, I think, it may be admitted that I know something about the Scheme in general.

There can be few, if any, in these enlightened days who are blind to the need and use of Scientific Research for Rubber or any other form of Agriculture, but there are probably some who consider that the Rubber Research Scheme has not advanced with sufficient rapidity, and, at times, I myself have been among these. But I realise that the Research Scheme, both during the ante and post Reconstitution periods, has worked under difficulties and disabilities, for which it was not alone to blame. Mr. O'Brien has dealt with the Slump and all its devastating and paralysing effects, so I do not intend to touch on that, but would delve into more ancient history.

Before the War there were two Schemes, of sorts, both of which were, if I remember correctly, private and voluntary, and both fell into abeyance during the War. Shortly after the War they were revived and amalgamated, and, with a substantial grant from Government, constituted a new Scheme Under this Scheme the Laboratories were built and the Experiment Station at Nivitigalakele opened, but after a few years it became apparent that the Scheme needed further reconstitution and that an Ordinance would have to be passed in the Legislative Council: for a time this hung over the Scheme like the Sword of Damocles with somewhat paralysing effects; more so, I consider, than should have been permitted; even so it was realised that Nivitigalakele was not sufficiently large as an Experiment Station, and efforts were made to obtain a further grant of land, but difficulties arose and we were balked on every

occasion, I mention this especially as I shall refer to it again later. But for these facts the reconstituted Scheme would have taken over a larger inheritance.

This brings us to 1930 and the birth of the New Scheme coincident with the Rubber Slump.

To turn now to a few of the achievements of the Scheme:

First and foremost we have the Experiment Station at Nivitigalakele where Ceylon clones are being tested for purposes of budding.

Those of us who have visited the Station and Laboratories and examined the records of these clones realise the immense amount of work being done: they are most elaborate and kept with the minutest detail. This is a work that does not come before the public and for which the Research Scheme seldom if ever gets any credit. Those who have studied the subject of Budded Rubber realise that there is yet a great deal to learn and prove as to the behaviour of the so-called proved clones of the F. M. S. and Dutch East Indies at any rate in Ceylon and what applies to these, applies with greater force to the unproved clones of Ceylon.

Secondly, Mr. O'Brien has produced a most useful book on Rubber Manufacture, a book that should be in the hands of every Rubber Planter, be he V.A., P.D., or S.D.

Finally, we have Mr. Murray's work on *Oidium*. It is quite within the bounds of reason to imagine that this disease, if left untackled, may prove to be as serious a menace to the Rubber Industry in Ceylon, as did Coffee leaf disease to the Coffee Industry. Mr. Murray has shown that it can be controlled and controlled successfully, at no outrageous cost. If this was the one and only achievement of the Rubber Research Scheme, I consider it would have justified its existence.

Before concluding there is a point I would like to impress on all critics of Scientific Research Schemes:

That is, that scientific results are not produced overnight. It is aptly said that "the mills of God grind slowly, yet they grind exceedingly small" I think it would be as apt to substitute the word Science for the word God.

The long talked of, and long sought Rubber Restriction Agreement has come upon us during the last few days. Let us hope it is the dawn of an era of prosperity and that funds will,

before long, be available to permit the Rubber Research Scheme to go ahead as it should; though, if the position justifies it, it may be necessary to consider a small temporary increase in the Export Duty to counteract the decreased exports under Restriction. The Scheme possesses an estate, Dartonfield, where field experiments can be carried out: it has its Factory, and Laboratories, its Experiment Station for proving clones; and, in this connection, I see Government is being asked for a further grant of 100 acres of land; it is to be sincerely hoped that the same difficulties will not be experienced over this as in the past, to which I have already alluded. And, what is more important, it has in its four scientific officers a very sound and able nucleus around which to build up a larger and more elaborate Scheme. Given funds, and sympathetic consideration from the powers-that-be, I feel sure that within a few years we should have a Research Scheme of which Ceylon might be justly proud.

THE UNITED STATES DEPARTMENT OF AGRICULTURE*

ITS STRUCTURE AND FUNCTIONS

IN the first half century of our national life the Federal Government gave little practical aid to agriculture. John Adams as early as 1776 introduced in the Continental Congress two resolutions relating to agriculture. The first proposed the encouragement of the production of certain agricultural commodities, and the second recommended that the Colonies take early measures for erecting and establishing in every Colony a society for the improvement of agriculture. George Washington proposed Government aid to agriculture in his first annual message to Congress; but at that time he simply suggested that it should be encouraged in a general way along with commerce and manufactures. He had progressed far beyond that point by 1796, when, in his last annual message to Congress, he remarked that as nations advance in population the cultivation of the soil becomes more and more an object of public patronage. "Institutions for promoting it (agriculture) grow up, supported by the public purse; and to what object can it be dedicated with greater propriety?" Nothing came of these proposals.

LINCOLN SIGNED ACT IN 1862

The Act creating the Department was signed by President Lincoln on May 15, 1862, and in that year $64,000 was appropriated for agricultural purposes.

SCOPE OF THE ORGANIC ACT

The Act creating the Department of Agriculture directed it to acquire and diffuse useful information on subjects connected with agriculture in the most general and comprehensive sense.

THE PRESENT STRUCTURE

The United States Department of Agriculture is one of the 10 major executive departments of the Federal Government. Its affairs as a whole are supervised and controlled by the Secretary of Agriculture. He formulates and establishes its general policies. His extra-departmental functions include contacts with Congress, to secure necessary appropriations and to advise regarding pending agricultural legislation; contacts with other executive departments, to co-ordinate inter-departmental activities and to avoid duplication in work; and membership on numerous boards and commissions, such as the Executive Council, the Forest Reservation Commission, and the Migratory Bird Conservation Commission.

In his task of supervising the work of the Department, the Secretary is assisted by a general administrative staff, including an Assistant Secretary, four Directors of principal types of work and a Solicitor. The

* Extracted from United States Department of Agriculture Miscellaneous Publication No. 88, December 15, 1933.

Assistant Secretary aids in the general supervision of the Department and acts for the Secretary in his absence. In the absence of both the Secretary and Assistant Secretary, the Chief of the Weather Bureau becomes the Acting Secretary of Agriculture.

FUNCTIONS OF THE DIRECTORS

Each of the four Directors supervises the work of the Department pertaining to his special sphere, and reports directly to the Secretary. There are Director of Scientific Work, the Director of Extension Work, the Director of Personnel and Business Administration, and the Director of Information. In many cases the responsibilities of the Directors are connected with many of the Department's bureaus and sometimes with them all. Their function, consequently, consists largely in co-ordinating the various activities so as to avoid duplications, to save time and money, and to forward a sound agricultural program. In addition to this general function, each of the directors has an organization under his immediate control. Thus the Chief of the Office of Experiment Stations reports to the Director of Scientific Work. The Director of Extension Work has under him the Office of Co-operative Extension Work, the Office of Motion Pictures and the Office of Exhibits. The Director of Personnel and Business Administration is in charge of the offices dealing with finance, personnel, salary classification, department organization, and general business operations. The Director of Information has immediate charge of the Office of Information, comprising the Division of Publications, the Press Service, and the Radio Service. The Solicitor, who is legal adviser to the Secretary, has a large staff of assistants.

SIX GENERAL CLASSES OF WORK

All the Department's ordinary activities — i.e., not including emergency adjustment work — may be divided roughly into six general classes: (1) research; (2) extension and information; (3) eradication or control of plant and animal diseases and pests; (4) service activities, such as weather and crop reporting, and forest and wild life refuge administration; (5) the administration of regulatory laws; and (6) road construction. These functions are closely inter-related and interdependent. Research, for example, is not complete in itself. Knowledge gained must be communicated to the public, used in eradicating plant and animal pests, and incorporated in regulatory-law administration. It is as essential a duty of the Department to promote the application of science as it is to increase scientific knowledge. These manifold duties though not the result of a preconceived plan, did not come about fortuitously. They developed from small beginnings in directions determined by agricultural and national wants and by the growth of science. The Department is not a mechanical creation but a living institution evolving structurally and functionally in a changing world.

RESEARCH

Research, of course, is fundamental in the Department's work. All interests today recognize that the Federal Government should promote agricultural science. It is a public, rather than a private, function because agricultural research does not ordinarily attract private enterprise. Individuals and corporations seldom have the public spirit, the scientific interest, or the financial resources to conduct agricultural research efficiently.

We may distinguish between research for more or less well-defined practical objects, and fundamental research for the discovery of basic facts and principles. The first type may be undertaken to throw up a hurried defence against diseases and pests, to develop plant varieties or strains of livestock suited to particular conditions, or to find new uses for crop byproducts. Fundamental research is not always directed toward any clearly defined practical goal. It explores physical or biological phenomena, primarily to increase the sum of knowledge rather than to attain any specified tangible advantage. This does not mean that fundamental research is not practical. It is practical in the highest and most permanent sense. Time and again fundamental research has developed facts or principles of revolutionary practical importance.

PUTTING SCIENCE INTO PRACTICE

Service functions grow out of the Department's research. Knowledge gained by the study of animal diseases and parasites is the basis of control measures. Diagnosis of foot-and-mouth disease on its rare appearances in this country has led to its prompt and complete eradication. The same is true of the infectious poultry malady, European fowl pest, which appeared in the United States in 1924 and was eradicated in 1925. It made a second appearance in June 1929, but prompt diagnosis led to its speedy suppression. Research helps to eradicate or prevent bovine tuberculosis, tick fever, hog cholera, sheep and cattle scabies, diseases of animals on fur farms, and various other maladies. Several years ago the Department proved that anaplasmosis, a disease of cattle, exists in this country, and the knowledge led to experimental methods of control and treatment. A study of the so-called mosaic diseases of tobacco, tomatoes, cucumbers, potatoes, sugar beets, corn, wheat, sugarcane, and many other cultivated crops, including fruits, resulted in the development of resistant varieties and the establishment of these varieties in threatened areas.

ACCOMPLISHMENTS OF ENTOMOLOGY

The cotton bollweevil, one of the worst insect pests, has been brought under a large degree of control by thorough dusting of the cotton plants at appropriate times with powdered calcium arsenate. The discovery of the susceptibility of the insect to certain arsenical poisons gave cotton growers a means of decreasing its injury to the cotton crop even during the worst bollweevil years. The result is a net benefit averaging $15 an acre.

Curly top, a serious malady of the sugar beet, is attributed to a small leafhopper. This pest normally migrates from the desert into beet fields, carrying with it a virus which produces the malady of sugar beets. An entomologist trained also in ecology discovered the influences which result in the migration of the insect and the conditions under which migration is likely to take place. Hence the Department can inform growers, in time for the information to have a bearing on their sugar beet planting, whether an abundant or a light infestation of the pest that causes curly top is likely to occur during the coming season. Recently Department scientists developed a variety of sugar beet which is resistant to the curly top disease.

CORRELATING DISEASE KNOWLEDGE

That plants, like animals, are subject to disease has been known from the beginning of history. The Bible frequently refers to "blights and mildews" of plants and Aristotle, B.C. 300, speaks of the rust of wheat. It is only within the last hundred years that the fundamental discovery was made of the relation of fungi, bacteria, and other microscopic organisms to plant diseases. Pear-blight was the first bacterial disease of plants to be so recognized. Why the disease often developed almost at once on the whole bloom of the tree, however, was still a mystery. One morning, in the Department's grounds at Washington, a member of the Department saw a bee dive into a pear blossom. He caught the insect, removed certain adhering substances from its head and body, and looked at these substances through a microscope. He found the pear-blight organism. Thus was established the important fact that a bacterial plant disease can be carried from one plant to another through the agency of an insect, and the simultaneous development of pear-blight on many blossoms was explained.

This discovery was followed 2 years later by the discovery that splenetic or tick fever is transmitted by the cattle tick. The joint responsibility of bacteria and parasites in the causation of certain mysterious plant and animal diseases was revealed and a basis laid for effective control of such diseases. Through quarantine action in the Southern States cattle ticks were eradicated from large areas and cattle freed from a disease that had formerly caused heavy losses. Out 985 counties that were quarantined when systematic tick eradication began in 1906, only 89 still had to be kept in quarantine at the end of 1933. This is one of the most outstanding successes of regulatory action based on scientific discovery in the Department.

Benefits derived from the revelation that plant diseases may be transmitted by insects and other invertebrates have not been confined to agriculture. In the tick-fever investigation it was demonstrated that the actual cause of the disease is a micro-organism found in the blood of infected cattle, and that the cattle tick is the only means whereby the disease can be transmitted. This proof that a protozoan disease may be transmitted exclusively by an intermediate host or carrier led to the knowledge that yellow fever, malaria, typhus fever, African sleeping sickness, Rocky Mountain fever, nagana, and other diseases are similarly communicated. It made possible the control of yellow fever in the Panama Canal Zone. Many plant diseases, including sugarcane mosaic and sugar-beet curly top, are transmitted by insects.

TRIUMPHS IN PLANT BREEDING

Another branch of study in the Department that has had important practical consequences, including the enactment and enforcement of certain regulatory laws, is plant breeding. In the strict sense, plant breeding is a comparatively new development, though plant improvement has been going on since man first became interested in plants. Methodical plant breeding was unknown before the discovery that plants are male and female.

This fact, though previously suspected, was not definitely established until less than 2 centuries ago. The greatest progress in plant breeding

is a development of the last 20 or 30 years. Plant breeding in the Department of Agriculture has developed plant varieties that thrive where the varieties previously known could not, and has improved the quality, the yield, the disease resistance, and the climatic adaptability of many crops.

Among early triumphs in this field was the discovery of important facts about cotton wilt and about the nematode diseases of cowpeas and other leguminous crops. Through plant breeding the potato industry has been protected and the sugar industry of Puerto Rico and Louisiana re-established. Plant breeding has pushed up the northern boundary of spring wheat and promises to do the same for winter wheat. The discovery that resistance to disease and to climatic conditions is a genetic character which may be bred into or bred out of plants constitutes the justification for such legislation as the Federal Seed Act. This law requires that all seed of alfalfa and red clover imported into the United States shall be artificially colored, so that the purchaser may know whether he is buying seed of domestic or foreign production.

PLANT IMPORTATIONS

Research and service activities are combined in the introduction of foreign plants, which has been a major function of the Department ever since it was created. As already noted, plant introduction long antedates the creation of the Department. It was practised by the early settlers, and was promoted after 1839 through the Patent Office. All our field crops, except tobacco and corn and a few lesser crops have been introduced from foreign countries. The original home of the potato is below our southern boundary. In the last 30 years or so plant-introduction work in the Department has been systematized and scientifically controlled, and its value much increased. Citrus fruits, durum wheat, alfalfa and Sudan grass, acala cotton, numerous important varieties of soybeans, Japanese plums, vinifera grapes, Persian walnuts, figs, and many other valuable crops have been introduced.

Highly trained plant explorers seek valuable new plants in all parts of the world. These plants, when received into the United States, are tested and cultivated to determine their importance to American Agriculture. Entomologists and pathologists carefully inspect each shipment for pests and signs of disease. All imported seeds are fumigated regardless of their origin, and many bulbs are treated with hot water to kill nematodes. Specimens from countries where especially dangerous pests or diseases occur are given additional treatment. Quarantine houses are maintained where the imported plants may be grown under observation, to disclose any condition not apparent on their arrival. In short, botanical and pathological studies go hand in hand with the propagation and establishment of the new varieties. Some idea of the scope of the Department's plant-introduction work is evident from the fact that the serial numbers given to the imported specimens now run above 100,000. The numbering system was started about 25 years ago.

SOME RECENT ACHIEVEMENTS

The stream of research accomplishments continues to flow. In a single year (1932) the Department reported dozens of achievements important as contributions to the country's economic welfare, as well as to the growth of science. It may be useful to mention just a few of these.

Investigators discovered that endemic typhus fever, a debilitating disease of man which had been increasing in the eastern and southern parts of the country, is transmitted by a mite that attacks the tropical rat. They found also that a small gnat caused pink eye or conjunctivitis, a serious scourge in many parts of the United States, especially among school children. The Department developed a curly top resistant variety of sugar beets which under curly top conditions produced on the average 4½ tons more beets per acre than did the commercial strains used locally. Sugarcane investigations indicated means of decreasing the deterioration of mill cane, of decreasing losses in the recovery of sugar, and of extending the length of the season during which cane may be milled in Louisiana.

In co-operative experiments at the California Experiment Station, early maturing hybrid selections of rice produced better yields than the principal early-maturing varieties, Colusa and Onsen, now grown commercially. The Department developed a new early wilt-resistant tomato named "Pritchard" that appears to rank with Marglobe in excellence and probable future importance. In recent years in the United States the annual injury to beans from seed-borne diseases has run as high as $4,000,000. In 1931 the Department demonstrated that the use in the Eastern States of seed from the Western States will greatly reduce seed-borne diseases. Strains of sweet corn resistant to bacterial wilt, a disease that caused severe damage in 1931, were produced in co-operative experiments with the Indiana State Experiment Station.

Two pedigreed varieties of fiber flax, developed by years of selection, proved superior when tried out in field tests in eastern Michigan in comparison with other fiber flax grown for seed and upholstering tow. A sudden and severe outbreak of downy mildew on hops in Oregon and Washington required the aid of Department scientists. Bordeaux mixture proved an effective control agent. Strains of tobacco resistant to black root rot were developed by the Department in co-operation with State Agencies.

The Department demonstrated that there is a marked difference in the vitamin content of hays. Cows fed for long periods on inferior roughage decline in general health, reproductive ability, and milk production. Investigators found that dairy barn temperatures affect milk yields; temperatures maintained between 45° and 60°F. gave the best results under northern winter conditions. Animal parasite studies conducted with the Oklahoma Station disclosed for the first time that three species of ticks can transmit anaplasmosis, an infectious febrile disease of cattle, from infected to susceptible animals. Investigations revealed that a species of round worm probably causes certain lesions in the livers of swine. Such lesions result in the condemnation of the livers at federally inspected slaughtering establishments.

Asparagine, a rare and expensive amino acid formerly obtainable only from Europe, can now be produced in this country as a result of biological investigations in this Department. Asparagine is valuable in investigations of bovine tuberculosis, the organisms of which make exceedingly good growth on culture media containing asparagine.

Discoveries by this Department have helped to place the United States well on the road to independence in fertilizer materials. So far as nitrogen is concerned, the monopoly is over; research in the Department fostered

the production in the United States of cheap nitrogen from the air by a synthetic ammonia process. Though this country continues to import most of its potash, it has a substantial and growing potash industry, and American production promises shortly to be the controlling factor in domestic prices.

A new process has been developed and successfully tested whereby with the use of ammonia and carbon dioxide, potash and ammonium sulphate can be easily manufactured from polyhalite, the potash mineral recently found in large subterranean deposits in western Texas. If the results of the potash work of this Department were applied to the 1930 bill of $22,000,000 for fertilizer potash, this would represent a saving of $13,574,000.

Two new insecticides, deguelin and tephrosin, may prove valuable additions to the list of organic insecticides that can be used freely on vegetation without injuring it. Chemists discovered these insecticides in several tropical plants, derris root, cube root, and certain species of Tephrosia. Rotennone occurs in derris root, and in the cube plant. This valuable new insecticide was further developed by the Department's chemists. It is more toxic than pyrethrum to many insects. Various mechanical appliances developed by the Department's agricultural engineers helped to reduce farm costs of production. To combat the European corn borer, engineers devised a simple stalk shaver for cutting cornstalks flush with the ground. They developed experimental machines for applying fertilizers accurately at predetermined rates and in various positions with respect to the seed. Chemical and plant research had demonstrated the importance of this.

Two new fumigants for insects infesting grain and other agricultural products in storage were developed by the Bureau of Entomology and the Bureau of Chemistry and Soils. These fumigants are now widely used throughout the country for treating a great variety of products, including clothing and house furnishings. These new fumigants are the ethylene dichloride-carbon tetrachloride mixture and the ethylene oxide-carbon dioxide mixture. They are efficient, non-explosive and involve little or no risk to the operator.

Light plays an important rôle in the development of rancidity in foods. This was recently demonstrated by the Department in experiments that led to the granting of a public service patent to make the discovery available to the American public. The experiments showed that the portion of the spectrum lying between 4,900 and 5,600 Angstrom units, which imparts the color approximately chlorophyll green, prevents or delays rancidity. Temporary storage of some fruits and vegetables in atmosphere relatively high in carbon dioxide is an effective substitute for precooling, scientists discovered. This treatment holds rot organisms in check and delays the ripening process somewhat.

The Department showed how waste and costs may be reduced in handling and transporting fruits and vegetables. In orange shipments from California to eastern markets a new method permits safe shipment with only one reicing in transit instead of the 10 or 12 reicings required

under the standard refrigeration previously used. With dilute nitric acid as the pulping agent, the Department developed a process for making high-grade cellulose from bagasse, the waste from sugarcane after the sugar has been extracted.

Work on lignin, a component of all agricultural wastes showed that several synthetic resins can be produced from it, as can eugenol, the essential constituent of oil of cloves, and vanilin, the flavoring constituent of vanilla. By processes developed in this Department, industrial chemists produced from agricultural wastes in 1932, more than 1,000,000 pounds of furfural. Some 5,000,000 pounds of oat hulls, which would otherwise have been wasted, were thus utilized.

Inulin, the principal constituent of chicory root, is thought to be the most suitable carbohydrate available for the diet of persons suffering from diabetes. Recently the Department devised a method of producing extremely pure inulin by a simple and cheap process, the most suitable source being chicory, now grown in limited quantities in the United States as a coffee substitute. Experiments at the Department's laboratory of fruit and vegetable chemistry at Los Angeles developed a new fruit product, frozen fruit pulp, which promises to afford a new and profitable outlet for fruit heretofore graded low and sold at a low price.

By a process recently developed in the Department, milk sugar can be removed from skim milk without affecting the casein. This process is particularly valuable to the icecream industry. Investigations developed means of preventing the crystallization of sugar from cane sirup and of controlling the flavour and color of cane sirup by the use of decolorizing carbon. This was an important step toward the more uniform production of high quality sirup.

AGRICULTURAL RESEARCH*

SUCCESS or failure in agriculture, as in every other art or industry, depends on "comparative efficiency." The farmer succeeds or fails in proportion as he produces the better article, and produces it more economically than his competitor producing a similar article. The better quality product, produced in greater quantity to the acre beats the inferior and less "economic" product off the market. And, as in industrial production, the race is never won. It is continuous and everlasting. Every day the research worker is breeding more efficient plants, is breeding and feeding a more economic domestic animal—success is to those in the vanguard of this perpetual progress: failure to those that lag behind. We cannot afford to resist this law of change or disregard the ever-expanding discoveries of the scientific worker.

Organised agricultural research has usually begun as defence against plant and animal disease. Some pest or fungus attacks a crop and we seek the help of the bug hunters (entomologists) and mould fighters (mycologists) to protect our crops from these attacks, just as we go to a doctor when we are ill. Now, just as "preventive medicine", sanitation, etc., is seen to be more important than the cure of pathological conditions, so, in agricultural research, the best protection of plants and animals against disease is a robust constitution, and disease-resistant factors, which can be bred or maintained by special feeding.

The bulk of the higher modern agricultural research work in the world has developed into three main types of scientific effort — the work of the geneticist or breeder, the work of the physiologist, and the work of the nutritionist or feeder. Perhaps I ought to add the "ecologist" the man who studies the environment of a plant or animal and seeks to establish what are its optimum conditions of climate, soil (in the widest sense), light supply, etc. Of course, the process of "seed selection," cross-breeding of animals, manuring of plants and special feeding of domestic stock, have always gone on in agriculture. But, nowadays, these often chancy or empirical advances of the past have been superseded by the more scientific, fundamental and long-range research of the geneticist and the nutritionist.

The agricultural research stations which seem to be making the most remarkable advances in new discovery to be leading in the race for agricultural efficiency are those "one crop" stations, where a team of specialist workers concentrate on the improvement of the economic efficiency of one crop. In them with the geneticist leading the plant physiologist, the biochemist, the ecologist, the entomologist, the mycologist, set out to solve problem after problem with a view to producing new types and new varieties of greater economic efficiency than the existing ones, and of controlling or supplying the (often obscure) environmental conditions under which that efficiency can best be realised.

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* By the Rt. Hon. W. Ormsby-Gore, M.P. in the *Journal of the African Society*, January, 1934.

The scale and range of some of these stations is enormous, including as they do, not merely the creation of new varieties, but all the problems of manuring, irrigation, and improved technical handling of the crop. Probably the largest and in many ways the most remarkable, are the new sugar beet and potato research stations in Soviet Russia. In the tropics, the research stations in Java, and especially the great sugarcane research station at Passaruan, are the most up to date and successful.

What both Governments and farmers frequently fail to realise is that we have now reached a stage of knowledge and experience in these matters where the making of further advances, as regards many of the world's staple crops, involves the organised team work of many specialists over a series of years. The demand of the layman is for quick results for expenditure in research. This demand is often quite impracticable, and its mere existence has often diverted the team of workers from what they know to be the better, and ultimately more useful, but longer, piece of work, in favour of something shorter in time, but less important in result. For there must be no misunderstanding that the most important advances are nearly all the result of uninterrupted work on a problem, for anything from five to ten years.

Research is necessarily expensive. Not only is the whole apparatus of the agricultural research worker a fairly expensive business, but the worker himself has nowadays to go through a long period of university and post-graduate training, and, in order to keep up to date, has to be fed with literature and translations from contributions by other workers in the field in many different languages. And, above all, the supply of the really qualified men is pretty limited. There is somewhat of a vicious circle at present in this last matter. There are few men because there are few jobs offering. On account of the world-wide commodity slump, at this moment there are more men capable of good research work than there are jobs at any rate in the British Empire overseas, a strange contrast to conditions obtaining a few years ago.

It is not easy to bring home to the average citizen of the British Empire, with his general and most universal tradition of literary and classical education, the significance of modern science. Even where he has included in his education some smatterings of modern science, his knowledge in the main is linked to physics and chemistry. For most British people biology is either a closed book or limited to a little botany or zoology. Some decimal of one per cent. may have heard of Pasteur, a smaller decimal of the Abbe Mendel. Genetics—even plant genetics—is still something under taboo as a school subject. Consequently the politician and the administrator, the treasury controller and the general public don't begin to know what the agricultural research worker thinks about. They don't begin to comprehend his language, still less to understand the character of his work. This ignorance is a serious danger to the whole economic future of those parts of the Empire that are dependent on agriculture, and particularly on the export of agricultural products in competition with world markets. We are skilled in handling legal, transport and industrial problems, but tiros at modern biology. Our research institutions in the

Colonial Empire are few, small and short of money and personnel. The few we have are good, especially the College and the Cotton Research Station in Trinidad. Trinidad in a few short years has already made a real difference: but we are behind the vanguard in the race and we cannot henceforth afford to leave it to the Dutch, the Russians and the Americans to lead us. We are already suffering in competition from a want of knowledge and a want of intelligent imagination in this whole subject. Our whole educational curricula have been based on an old stable civilisation and on conditions that are fast changing. The most serious gulf to be bridged is the intellectual gulf between the actual research worker and the people with power who alone can provide him with the support and opportunities, without which the research worker cannot help them.

MEETINGS, CONFERENCES, ETC.

RUBBER RESEARCH SCHEME (CEYLON)

Minutes of the twenty-first meeting of the Board of Management held at 11 a.m. on Thursday, May 17, 1934, in Room No. 213, New Secretariat, Colombo.

Present.—Dr. W. Youngman (in the chair), Messrs. C. H. Collins (Deputy Financial Secretary), L. B. de Mel, J.P.,U.P.M., H. R. Freeman, M.S.C., L. P. Gapp, F. H. Griffith, M.S.C., Col. T. G. Jayewardene, V.D., M.S.C., Messrs. J. L. Kotalawala, M.S.C., F. H. Layard, P. R. May, F. A. Obeyesekere, M.S.C., C. A. Pereira, B. M. Selwyn, E. C. Villiers, M.S.C., and Col. T. Y. Wright.

Mr. T. E. H. O'Brien, Director of Research, was present by invitation and acted as Secretary.

Apology for absence was received from Mr. C. E. A. Dias, J.P., and from Mr. B. F. de Silva.

BOARD

The Chairman reported the following changes in membership of the Board:—

(a) Nomination of Mr. L. B. de Mel, J.P.,U.P.M., in place of Mr. A. E. de Silva who had resigned.

(b) Renomination of Mr. I. L. Cameron for a further period of 3 years from April 25, 1934.

(c) Nomination of Mr. F. H. Layard to act for Mr. I. L. Cameron during his absence on leave, with effect from May 8th.

(d) Nomination of Mr. C. H. Z. Fernando to take the place of Mr. F. A. Obeyesekere on completion of the latter's 3-year period of office on May 29, 1934.

The Chairman welcomed new members to the Board and took the opportunity of thanking those who were retiring for their services.

OIDIUM LEAF DISEASE

Consideration was given to proposals for future experimental work on *Oidium*, which provided for (a) a sulphur dusting experiment over an area of 100 acres in the Kalutara District (b) co-operation with estates in trials of different brands of sulphur, maximum effective quantity per acre and optimum interval between successive applications (c) lectures and demonstrations to District Planters' Associations (d) the issue of a leaflet giving practical information to assist estates undertaking sulphur

dusting (e) preliminary enquiries regarding the possibilities of dusting from aeroplanes. The proposals were adopted and funds voted for the necessary expenditure in the current year.

STAFF

(a) The Chairman reported that Mr. M. W. Philpott had arrived in Ceylon on May 7th and that his agreement would date from April 13, 1934, the date of embarkation for Ceylon.

(b) The appointment of Mr. C. D. de Fonseka as Secretary to the Director of Research from April 3, 1934, was reported.

BUILDINGS AT DARTONFIELD

(a) *Experimental Factory.*—A recommendation of the Estate Committee to provide 3 additional bays in the experimental factory at an extra cost of Rs. 6,000/-, was approved. The Director of Research reported that he expected to have the factory site and approach road ready by June 15th.

(b) *Chemist's Laboratory.*—Proposals were considered for the erection of a laboratory and equipment with power connections and batteries, petrol gas plant, water supply, benches etc., at an estimated cost of Rs. 23,882/-. An inclusive vote of Rs. 25,000/- was approved and the Estate Committee was authorized to make decisions regarding the acceptance of tenders and to proceed with the work.

MINUTES OF THE MEETING OF THE CENTRAL BOARD OF AGRICULTURE

THE inaugural meeting of the reconstituted Central Board of Agriculture was held in the Board-room of the Department of Agriculture, Peradeniya, at 2.30 p.m. on Thursday, May 10th, 1934.

His Excellency the Governor presided, and the following members were present: the Director of Agriculture, Sir H. Marcus Fernando, the Hon. Mr. C. W. W. Kannangara, Messrs. F. A. Obeyesekere, M.S.C., E. C. Villiers, M.S.C., G. Robert de Zoysa, M.S.C., D. H. Kotalawala, M.S.C., P. B. Ranaraja, M.S.C., C. V. Brayne (Commissioner of Lands), W. K. H. Campbell (Registrar of Co-operative Societies), B. G. Meaden (Director of Irrigation), A. B. Lushington (Conservator of Forests), C. L. Wickremesinghe (Government Agent, N.C.P.), M. Crawford (Government Veterinary Surgeon), J. Light (Assistant Government Agent, Kalutara), B. M. Selwyn (Chairman, Planters' Association of Ceylon), R. Sri Pathmanathan (Chairman, Low-country Products Association), James Forbes (Jnr.) (Chairman, Tea Research Board), Dr. R. V. Norris (Tea Research Institute), Mr. T. E. H. O'Brien (Rubber Research Scheme), Dr. R. Child (Coconut Research Scheme), Dr. J. C. Hutson, Mr. F. P. Jepson, Mr. M. Park, Dr. A. W. R. Joachim, Dr. J. C. Haigh, Mudaliyars S. Muttutamby and N. Wickremaratne, Mr. S. M. K. B. Madukande, Dissawa, and Messrs. S. Armstrong, C. Arulanbalam, P. B. Bulankulama, L. G. Byatt, A. Canagasingham, F. C. Charnaud, R. G. Coombe, Wace de Niese, Leslie de Saram, L. W. A. de Soysa, C. E. A. Dias, H. D. Ditmas, G. B. Foote, R. P. Gaddum, D. C. Gordon-Duff, Col. H. D. H. Gwynn, Messrs. John Horsfall, Montague Jayawickreme, E. E. Megget, Graham Panditteseke re, U. B. Unamboowe, Rev. Father L. W. Wickremesinghe, Mr. C. Huntley-Wilkinson and Mr. W. C. Lester-Smith (Secretary) and the following visitors: the Hon'ble Minister for Agriculture, Captain G. M. Oliver, Mr. (now Sir) S. Pochkhanawala (Chairman, Ceylon Banking Commission), and Messrs. A.G. Baynham, S. J. F. Dias, J. W. Ferguson, H. D. Garrick, G. K. Newton, H. A. Pieris, and R. Sabaratnam.

Letters or telegrams were received from the following members regretting their inability to attend: Gate Mudaliyar A. E. Rajapakse, M.S.C., and Messrs. Gordon Pyper, G. C. Slater (Chairman, Tea Propaganda Board) and Rolf Smerdon.

The Chairman, Dr. W. Youngman (Director of Agriculture) in welcoming His Excellency the Governor said:

"I am sure that I am voicing the feeling of all present here today when I thank Your Excellency for so kindly consenting to come and preside over this first meeting of the newly-constituted

Board of Agriculture. Since the old Board in its old form ceased to be, when the period of office of its Committees was not again renewed more than one auspicious event has happened in this Island. Firstly, there has been the arrival of Your Excellency to guide its destinies, coincident with which came returning prosperity to the tea industry and more recently to the rubber planter, and we have reason to hope as a result of Your Excellency's suggestion and thought our friends whose interest is in the coconut will be able to devise ways and means that shortly will bring them some measure of relief from the depression that has overtaken them. We cannot therefore but regard Your Excellency's presence among us other than as a particularly good omen.

"The old Board of Agriculture, several of whose members we are glad to see here today as members of the new Board, and of the some who are not members, we shall always be pleased to welcome as visitors, was constituted by Ordinance No. 37 in 1921.

"The objects of that Board were to advise Government on all matters and questions in connection with the agricultural industries and to make recommendations in connection with such questions. That Board was divided into three standing Committees, an Executive Committee, an Estate Products Committee and a Food Products Committee.

"As an Advisory Board a Sub-Committee in 1927 formulated useful proposals for the further extension of the work of the Agricultural Department. The Executive Committee of the Board however, did not function. The Food Products Committee was difficult to get together in sufficient numbers to form a quorum and subjects of importance to village agriculture did not receive adequate attention.

"The most valuable outcome of its work was the comprehensive survey, Province by Province, of the Paddy Industry of this Island, which led to the recommendation by the Board that a Paddy Commission should be formed. This action was taken on the eve of the change in the constitution when an Executive Committee of the State Council itself shortly afterwards became responsible for paddy production amongst other phases of agriculture and the Commission was dissolved, being redundant.

"The Estate Products Committee fully justified its existence and its bi-monthly meetings at Peradeniya were valuable and spirited discussions, rarely lacking a very full agenda and a full attendance. That Committee can certainly claim many things of value to its credit. The discussions alone allowed many members of the tea, rubber and coconut plantation industries to learn much from their fellow-planters and to hear the opinions of the Peradeniya Scientific Staff and later of our Research Institutes. The practices of green manuring and cover cropping were introduced on estates largely as the result of these Peradeniya discussions and attention was focussed on the danger of soil erosion which did lead to some measure of amelioration, if not yet to so full an extent as could be wished. The meetings, also, in large measure directed attention to the pests and diseases inflicting damage on our crops and played a large part in devising measures for their control.

"There could be little wonder that those interested in village agriculture should look at the success of the Estate Products Committee and seek to engraft on to it in some way an equal enthusiasm for peasant crops. It was, I believe, largely that idea that decided the Hon'ble Minister for Agriculture in his intention to revise the constitution of the Board of Agriculture.

"The Board as now organised consists of a Divisional Association of local members in each Chief Headman's Division, the Headman being the Chairman, which makes representations and sends representatives to the District Committee. Each District Committee is, together with organisations and selected gentlemen taking a special interest on agriculture, represented on this Central Board. In addition we welcome to this Board as visitors, who may take part in its discussions, any who are interested in the agricultural welfare of this Island.

"The success of the new Board will, I believe, largely depend upon the amount of enthusiasm and self-help that can be inspired through its trinity of Associations, Committees and Central Board into the agriculturalists of the countryside. Self-help must always be the greatest factor in the success of an agricultural community. Thrift, co-operation, industry, improvement in the village, all depend upon this factor of self-help. The duty of a State Department of Agriculture is very largely to inculcate and encourage this element in the rural districts. I believe I may with the best of good intentions emphasise my belief that the greatest good will be achieved by those bodies that can to the greatest extent organise a spirit of mutual assistance amongst themselves rather than merely drift into discussion of Utopian ideals which rarely materialise. Recommendations by Village Committees and authorities that the Agricultural Department should present to someone fifty orange trees, a pedigree cockerel, or a stud bull are common, but the resources of a State Agricultural Department are limited. Where the Agricultural Department sees genuine attempts at organisation and self-help it will not be slow in giving assistance to the utmost of its resources and encouraging enthusiasm that has been or can be kindled. The opportunity of this new Board lies, I believe, in the village, in kindling this spark of self-help and affording every encouragement to estate agriculture where it does already exist, by the consideration as in the past of those agricultural problems of importance to our planting industries."

H. E. THE GOVERNOR

His Excellency the Governor then addressed the meeting and said: "Dr. Youngman and gentlemen, we have a fairly long programme before us, so that I think you will not expect me to waste your time in making speeches to you, especially after what Dr. Youngman hinted in his address as to the desirability of doing things rather than discussing abstract matters.

"I am very glad to have the opportunity of presiding at this first meeting of the Central Board of Agriculture, and I am very glad to see that it has been revised on what appear, as far as one can see at present, to be very practical lines. I think the Board is going to be more important in the future than it could have been in the past.

"We have had rather serious warnings lately of the danger of putting too much trust in one or two industries. Tea seems to have overcome its difficulties for the moment, but I take it that we cannot hope that any system of restriction can be made permanent and the time will come when the tea industry will have to exert its utmost energies to see that it does not loose the ground which it is able to recover.

"Rubber is still in the experimental stage so far as marketing goes, and nobody except the Minister for Agriculture, knows what the future is going to bring forth.

"Coconuts appear to be in as bad a condition as they have been in the memory of man — all of which, I think, leads up to the fact that in this essentially agricultural community we must do our utmost to see that all the agricultural forces of the Island are properly mobilised. I am not going to suggest, as an eminent statesman recently suggested, that it is the duty of all good Ceylonese to take to drinking arrack and toddy, but I do think the Board should devote a considerable amount of its attention to the possibility of increasing the use in this Island of coconut products. I would specially suggest that the question of industrial alcohol should be taken up in this connection. I know when we discussed the matter some twenty years ago, the difficulty was that the raw material was too expensive, and therefore you could not produce alcohol at a price which could compete with petrol. Now that the price of coconuts has gone down to about a tenth part of what it was then, I think it is time to reconsider that question.

"There are other minor agricultural products which I hope to see worked up. It is a matter of great regret to me to see that large imports of citrus fruits into this country, which I should imagine could be supplied locally. There are also other minor products in a similar situation.

"I have read with great pleasure a most interesting report by Mr. Crawford on the position of animal husbandry in this Island, which subject it is quite possible we shall not reach in the course of discussion if I waste any more of your time. I want to commend that report by Mr. Crawford to your most earnest attention."

The agenda items were then proceeded with:

I. ELECTION OF EXECUTIVE COMMITTEE

The names of the following members of the Central Board were proposed and seconded to serve on the Executive Committee: Messrs. James Forbes, (Jnr.), R. G. Coombe, D. H. Kotalawala, Sir Marcus Fernando, Gate Mudaliyar A. E. Rajapakse, Messrs. B. M. Selwyn, C. E. A. Dias, Rolf Smerdon, K. Balasingham and G. Robert de Zoysa.

The names of these ten were put to the meeting and their election was unanimously carried.

II. THE ADOPTION OF RULES

The following rules for the Board were adopted:

1. The meetings of the Board shall be held three times in the year, in January, May and September; and on any special occasion as may be desired by the President.

2. Every member of the Board who has not by December 31st in each year attended at least one of the meetings held during the preceding twelve months or during his tenure of office, shall be considered to have vacated his seat, unless he has been absent through ill-health or with leave.

3. At meetings of the Board twenty members shall form a quorum.

4. At each meeting the Chairman shall have an original vote, and in the case of an equality of votes he shall have an additional casting vote.

5. Thirty days at least before the date of a meeting of the Board, the Secretary shall post a notice of the meeting to each member of the Board. Notice of any subjects that a member may desire to be placed on the agenda of any meeting shall reach the Secretary ten days at least before the date appointed for the meeting.

6. The agenda of a meeting shall be posted by the Secretary to the members at least seven days before the date fixed for the meeting.

7. It shall be the duty of the Secretary to keep a proper record of the minutes of each meeting of the Board.

8. The meetings of the Board shall be open to the Press unless otherwise decided by the Board.

III. THE WORKING OF THE TEA RESEARCH INSTITUTE: ITS PAST ACCOMPLISHMENTS AND FUTURE PROGRAMME

Dr. R. V. Norris (Director, Tea Research Institute) then read his address, giving a brief review of some of the activities of the Tea Research Institute from its inception in 1925 up to the present time. He pointed out that no staff was recruited till 1927 and that it was only in the middle of that year that temporary laboratory accommodation was acquired at Nuwara Eliya.

It was made clear that the work of the Institute comprised two well defined stages; from 1927 to 1930, with headquarters at Nuwara Eliya, and from 1930 to the present time when the Institute had acquired its own estate and headquarters at St. Coombs, Talawakelle. The present organisation of the Institute followed a brief outline of the preliminary work, and major part of the present work was classified under the three headings: Laboratory investigations for the collection of fundamental data, which are designed to make clear the theoretical basis of the different factors involved in the cultivation and manufacture of tea. Field and factory experiments, designed to test out theories based upon the above work and to render these capable of practical application. Lastly, advisory work to estates, based on the results obtained. After touching on pruning and manurial experiments on tea, Dr. Norris referred to the work being done on tea diseases, insect pests, tea manufacture, and advisory work among small-holders. He concluded by drawing attention to the annual report of the Institute for 1933 in which details of the other activities of the Institute were to be found.

Mr. James Forbes, (Jnr.) (Chairman, Tea Research Board) then addressed the meeting and dealt with the various financial aspects of the work

of the Institute. He pointed out that the Institute is dependent for its revenue upon its estate and an export tax on tea fixed by Ordinance No. 12 of 1925 at ten cents per 100 pounds of tea exported.

This Ordinance also provided for the establishment of the Tea Research Institute, and by an amending Ordinance in 1930 the export tax was raised, at the request of those bodies representing the tea industry, for three years, from January 1931 to December 1933 to 14 cents per 100 pounds of tea exported. It was pointed out that during 1933 a control of exports of tea came into force and restricted the normal export by 15 per cent., in view of which the revenue of the Institute was appreciably affected and the State Council agreed to the maintenance of the export tax at 14 cents per 100 pounds of tea exported for 1934 only, and the matter is to again come up for revision shortly. The financial policy of the Tea Research Board was defined as being:

(i) To maintain the Institute and staff at such a level as to enable the work to be carried out with full efficiency, and with the maximum benefit to the Industry, including the small-holder.

(ii) To set aside annually a reasonable sum to cover depreciation of plant, buildings, etc., and

(iii) From revenue to set aside and accumulate a sufficient liquid general reserve to meet future capital expenditure.

After commenting on the last two items it was indicated that the Tea Research Board had estimated for the export cess to be maintained at 14 cents per 100 pounds of tea exported until the end of 1938, and that this had been unanimously agreed with by the Planters' Association of Ceylon, the Ceylon Estates Proprietary Association, and the Ceylon Association in London. In conclusion, Mr. James Forbes (Jnr.) applied for the approval of the meeting for his application to the State Council that the cess be maintained at 14 cents per 100 pounds of tea exported until the end of 1938, after which the matter could come up for further revision.

His Excellency the Governor pointed out that it was necessary for someone to move a resolution that the Central Board of Agriculture supported the application that the cess be maintained at 14 cents per 100 pounds of tea exported.

Mr. E. E. Megget then proposed a resolution on the lines suggested by Mr. James Forbes, (Jnr.), and referred to the way in which the American citrus industry had successfully met the citrus canker problem. He also referred to the value of the work of the Tea Research Institute in connection with dieback. Mr. F. A. Obevesekere, M.S.C., then suggested that the matter be left in the hands of the Executive Committee of the Central Board which had just been appointed. Mr. Huntley-Wilkinson put forward the view that this Board should give its opinion to the Executive Committee. His Excellency the Governor then pointed out that the Executive Committee was no more confined to the tea industry than the present Board, so that he held the view that it was well within the function of this Board to express an opinion, and that if members of the Board who specifically represent the tea industry saw an objection to the

cess being maintained at the rate mentioned, no doubt the Board would not accept the motion. Mr. C. E. A. Dias seconded the resolution which was carried unanimously.

IV. THE WORKING OF THE RUBBER RESEARCH SCHEME (CEYLON): ITS ACCOMPLISHMENTS AND FUTURE PROGRAMME

Mr. T. E. H. O'Brien (Director of Research, Rubber Research Scheme) in his opening remarks indicated that the Rubber Research Scheme was established by Ordinance No. 10 of 1930. The Board of Management consisting of representatives of the Treasury, the State Council, the Planters' Association of Ceylon, the Ceylon Estates Proprietary Association, the Low-Country Products Association, the Rubber Growers' Association, and Small-holders, under the Chairmanship of the Director of Agriculture. The 3½ years during which the Rubber Research Scheme, as at present constituted, has been in existence, it was pointed out, has coincided with the slump in world trade and the even greater depression in the rubber producing industry. The income of the Scheme is derived from a cess of ⅛ cent per pound of rubber exported, and, when the Ordinance was drafted it was anticipated that the exports would be in the neighbourhood of 75,000 tons per annum, representing an income of some two lakhs of rupees. There had been occasions during the past two years when the level of production fell to almost half this figure and, in view of the uncertain income, the Board of Management when considering development proposals refrained from any rapid scheme of development. The steady improvement in conditions during the past year has enabled a modest scheme of development to be undertaken, but the recently introduced restriction scheme would again have the effect of curtailing the income of the Rubber Research Scheme. It was pointed out that at the time of the establishment of the present Research Scheme, there was a body of the same name in existence, financed partly by voluntary subscription and partly by a *pro rata* contribution from Government, which handed over to the new Board of Management the staff, buildings and other assets belonging to the old Research Scheme. No account of the accomplishments of the old Scheme, Mr. O'Brien indicated, is included in this report. The present Research Scheme took over as technical staff a Chemist, a Mycologist and an Agricultural Assistant, as well as the laboratories and living quarters at Culloden Estate, Neboda, and an Experiment Station of 70 acres at Matugama. The lines of work of the Scheme are laid down in the Ordinance and it has been realised that with limited funds it is essential to concentrate on problems of special local importance while keeping in touch with work or problems of more general application in more important rubber producing countries. In view of the fact that such countries were ahead of Ceylon especially as regards the improvement of planting material by budgrafting and selection it has been the policy of the Research Scheme to maintain a balance between agricultural or "production" research and "consumption" research or work on promoting the utilisation of rubber. The work and proposals of the Research Scheme were then briefly detailed under the following sub-divisions: Agricultural problems; pests and diseases; the manufacture and utilisation of rubber; and advisory services. In connection with the last but one of these it was

stated that the scope of "consumption" research had just been extended by the appointment of an additional chemist. In conclusion, it was pointed out that the question of making information and advice available to the small-holder had not been overlooked and that proposals in regard to catering for their needs would be receiving attention in the near future.

Mr. G. Robert de Zoysa suggested that the results of experiments carried out by the Scheme should be published in the vernaculars so that small-holders might receive the full benefit of them. The Chairman (Dr. Youngman) indicated that this suggestion could readily be acceded to and that it was a sound proposal which Mr. C. E. A. Dias had had in mind for some time. There was no doubt whatever that the Scheme would carry it out.

Mr. G. Robert de Zoysa then enquired what steps were being taken by the Scheme to keep in touch with developments in regard to the processes for powdered rubber, especially in view of the strides in this connection made in the Dutch East Indies. He feared that if nothing were done to keep abreast of the subject Ceylon would be left behind; one of the advantages in this connection was that transport charges would be reduced.

Mr. O'Brien, in reply, stated that he had been in touch with both the Companies in Europe which were handling the processes for powdered rubber, one Company called the Rubber Powder Company and the other the Latex Rubber Powder Company. He understood that there was a possibility of a machine being used in Ceylon. From correspondence he had had he thought that commercial interests in Ceylon were very much alive to the possibilities of these processes and that Ceylon would not be left behind when commercial interests begin to see that there are commercial possibilities in the processes.

V. THE COCONUT RESEARCH SCHEME (CEYLON): ITS WORK AND PROGRESS

Dr. R. Child (Chief Technical Officer, Coconut Research Scheme) in reviewing the activities of the Coconut Research Scheme indicated that this Scheme was the youngest and smallest of those devoted to the three major crops of Ceylon. Though the Ordinance establishing the Scheme was passed in December, 1928, and the final selection of its headquarters on Bandirippuwa Estate was made in 1930 there were unfortunate delays over its purchase and they did not obtain possession until January, 1931. Building operations were commenced in November of that year and terminated with the laboratory block which was completed in March, 1933. Up till this time, as laboratory facilities were lacking, field work and estate visiting, especially in connection with the genetical side of the work was the main line of progress. The most urgent problems that need investigation were indicated as being accurate field experiments on manuring and cultivation. The preliminary work in this connection has been completed in a two-year statistical analysis of yield records which show that a twenty-tree plot is the most desirable. After touching on the lines of research of which this uniformity trial was the forerunner, Dr. Child passed on to the chemical studies on the utilization of coconut husk, coir fibre dust and coconut water, the manufacture of soap from coconut oil,

and the production of sugar from sweet toddy. He pointed out that in connection with the last point he had estimated from average yield figures that an acre of coconuts would yield 2½ tons of crude sugar, which is considerably less than the quantity produced by an acre of sugarcane. Coconut charcoal was indicated to be the one product of the coconut the demand for which at the present time exceeded the supply; various by-products from the production of coconut charcoal were indicated as lines of enquiry as to whether larger scale experiments were desirable. In conclusion, it was indicated that the Coconut Industry as practised on estates stops short at copra, and in some cases fibre; some factory problems were now being referred to the Scheme which might necessitate the transference of some problems from a laboratory to a works scale.

Mr. G. Robert de Zoysa intimated that his suggestion as regards rubber work, that the results of experiments should be published in the vernacular, applied with even greater force to coconuts and he hoped that the Scheme would consider the possibility of giving early effect to the proposal because a large percentage of the indigenous population was dependent on coconuts. Restriction, he considered, was not possible in the case of coconuts and they had to turn their attention therefore to the substitution of the products of the coconut for commodities which the Island now imported such as sugar and soap. The Scheme might also enquire into the possibility of devising a burner for coconut oil.

His Excellency the Governor in closing the meeting indicated his regret that on account of time they would have to forego the pleasure of hearing the papers of Mr. Crawford and Dr. Youngman. The meeting would also be deprived of the pleasure of listening to the observations of Mr. Bruce Foote in connection with rubber and Mr. Panditteseker on coconuts. He hoped that their observations would be published in a manner that would enable members to see them. His Excellency stated that he would like on behalf of all present to thank those gentlemen whose papers they had had the time and privilege to listen to for their very interesting addresses.

W. C. LESTER-SMITH,
Secretary,
Central Board of Agriculture.

PAPERS READ AT THE MEETING OF THE CENTRAL BOARD OF AGRICULTURE

REVIEW OF THE ACTIVITIES OF THE TEA RESEARCH INSTITUTE OF CEYLON

ROLAND V. NORRIS, D. Sc., M. Sc., F.I.C.

MY object this afternoon is to present to you a brief review of some of the activities of the Tea Research Institute. I am sure you will appreciate that in the short time at my disposal I can only cover a very small portion of the ground, and that I shall, therefore, have to omit altogether reference to a great many problems which we are investigating, confining my attention to a few of major importance and of more immediate practical interest.

It is not within my province to speak on the financial requirements necessary for the successful continuation and development of our work as this matter will be dealt with by the Chairman of the Board who is to follow me. In this connection I only wish to stress with all possible emphasis that it is impossible for a systematic and well-arranged programme of work to be arranged unless our probable financial resources for at least three or four years ahead can be foreseen. Continuity is an essential factor in research, particularly in agricultural research in which experiments in the field play a conspicuous part, and it is useless to arrange and lay down such experiments unless reasonably certain that funds will permit of these being carried on continuously for a reasonable number of years and that adequate staff will be available for their conduct and control. As examples of the disorganisation resulting from financial uncertainty, I need only point out that last year the appointment of a successor to Dr. Evans, our former Biochemist, was held up for six months and that we are now again placed in a similar position in regard to an Entomologist. I am sure this point will be appreciated by those here today and I feel confident that this meeting will give its full support to the proposals which the Chairman of the Board has to make.

Though the Institute was set up in 1925 no staff was recruited till 1926 and it was only in the middle of that year that a temporary laboratory was acquired in Nuwara Eliya. It is fair to say that it was not till the beginning of 1927 that work really started. The staff then comprised beside the Director, a Mycologist, an Entomologist and a Biochemist. An Agricultural Chemist was recruited in October 1927 and a section of Plant Physiology was formed in 1930. It was not, however, until the end of 1930 that the laboratories at St. Coombs were available.

The work of the Institute thus falls into two well-defined stages, the first from 1927-1930 with headquarters at Nuwara Eliya, when the staff were without any facilities for permanent field investigations and with very limited facilities even for laboratory work, and the second from 1931

onwards when the Institute had acquired its own estate at St. Coombs and had generally speaking adequate means for both laboratory and field work as well as a tea factory available for manufacturing experiments.

It is necessary to remind you of this because during this first period it was inevitable that work had to be of a preparatory nature and largely confined to the collection of fundamental data and to the more theoretical aspects of tea research. This was naturally of less immediate practical interest to the planter but was a necessary foundation for later work at St. Coombs.

To illustrate what I mean by preparatory work I will give one example. The final test of any cultural treatment must always be made in the field. A survey of the literature dealing with field experiments in tea in Ceylon and elsewhere at once showed, however, that but little was known of the errors inherent in such experiments and that little attention had been paid to field technique with the result that much of the previous work was of limited value owing to the fact that adequate precaution had not been taken to ensure that the accuracy of the experiment was great enough to distinguish between differences due to the treatment applied and those due to other variable factors.

It was essential, therefore, that before permanent field experiments were laid down, the technique of such work should be exhaustively studied. Actually this involved nearly two years' work. It may have appeared to many planters that this was of little practical interest. Actually it was of paramount importance as the results obtained enabled us, when land was available at St. Coombs, to lay down immediately field experiments which it may fairly be claimed have an accuracy considerably in excess of any similar work carried on elsewhere. The errors associated with such experiments can now be accurately assessed and, in consequence, the conclusions drawn from the results obtained can be accepted with a confidence that would otherwise have been wanting.

I do not, however, propose to go into further details of such preliminary work but shall pass on to describe our present organisation and indicate some of the results which have been obtained.

The work of the Institute may be roughly classified under three major headings:

(a) Laboratory investigations for the collection of fundamental data and designed to elucidate the theoretical basis of the various factors involved in the cultivation and manufacture of tea.

(b) Field and factory experiments designed to test out theories based on the above work and to bring these into a form capable of practical application.

(c) Advisory work to estates based on the results so obtained.

The policy behind all laboratory and field experiments is essentially the principle of team work, any problem being attacked simultaneously from as many angles as possible. Take, for example, a manurial experiment designed in the first place to examine the effect of different amounts of nitrogenous manures. This would be primarily the responsibility of the Agricultural Chemist. But the treatment given may effect the *quality*

of the made tea and this aspect of the case would be investigated by the Biochemist. Similarly the treatment may influence the susceptibility of the bush to insect and fungus attacks, necessitating the intervention of the Entomologist and the Mycologist. The fullest co-operation between the different divisions is, therefore, essential and this is ensured by the fact that all major experiments are most fully discussed and criticised, both before the experiment is begun and throughout its progress, by an Experimental Committee. This ensures, not only that the experiment is designed on the best lines possible, but also that secondary issues are not lost sight of. In other words the experiment is organised to yield the maximum amount of information with the least expenditure of time, labour and material.

Field experiments again are not confined to St Coombs. It was from the first realised that in view of the very varying conditions of elevation and climate under which tea is grown in Ceylon, work on many problems would have to be repeated at different centres. This will eventually lead, when finances permit, to the starting of small sub-stations at two or three centres. While no *permanent* sub-stations have yet been formed, thanks to facilities placed at our disposal, work has been continuously in progress during the past two years in the Ratnapura District, at Peradeniya and in Passara, in addition to work on small-holdings in the Gampola area. We have in fact four officers continuously engaged away from St. Coombs.

Of the many problems which awaited our investigation one of the most pressing was that of pruning, particularly pruning in the low-country. As you are aware very severe losses are incurred in the low-country due to the failure of bushes to recover from pruning. It was formerly considered that these deaths were due to a fungus disease of the roots commonly known as Diplodia root disease. In 1927, however, it was noticed by Dr. Gadd, the Institute's Mycologist, that such failure to recover from pruning was closely associated with a lack of food reserves in the bush at the time of pruning. The tentative suggestion was made, therefore, that the problem was possibly a physiological one and that the presence of the fungus was accidental or at any rate only secondary. On this basis lighter forms of pruning were advocated. Subsequent work lent further support to the above theory and hence when in 1930 a Plant Physiologist was added to our Staff, an investigation of pruning was immediately taken up as a major line of investigation.

These investigations have consisted in the comparison of three different types of pruning, a clean pruning, a cut-across and a rim-lung pruning, and have been carried out at three different elevations, viz. St. Coombs, Peradeniya and at Galatura in the low-country. At St. Coombs the effect of time of pruning is also under investigation.

Amongst many points of interest which have arisen from these particular experiments, the most striking is the very clear proof obtained of the great advantages resulting from the use of rim-lung pruning at low elevations in place of severer types of pruning. The essential feature of rim-lung pruning is that a considerable number of leaves, say two to three hundred, is left on the bush at pruning. The bush is thereby enabled to

continue its manufacture of food supplies and recovery is not solely dependent on the food reserves which, as is well known, are often quite inadequate in the low-country. The results obtained at Galatura show that rim-lung pruning, when compared against a clean prune, has reduced the number of deaths after pruning by no less than eighty-seven per cent. and the saving on this head alone amounted to more than Rs. 70/- per acre. But this is only part of the story. Not only is the number of actual deaths reduced but in the case of surviving bushes, the amount of pre-tipping dieback is reduced by nearly fifty per cent. This is reflected in larger bushes and a considerable increase in yield.

A cut-across also represents a lighter form of pruning but this not infrequently leaves much less leaf on the bush than might be expected and for this reason is less efficacious than a rim-lung prune. The latter has, moreover, one further great advantage in that the centre of the bush can be properly cleaned out and snags and unhealthy wood removed.

Any method which can reduce the amount of die-back after pruning is likely to have further results of major importance, for the snags thus formed afford ideal conditions for the entrance to tea bushes of *Calotermes* and foci from which wood rotting organisms can work. The results obtained by Mr. Tubbs are therefore of first class interest, not only in their immediate application but also in view of their ultimate bearing on the health of low-country tea.

I must pass on now to another type of work — manurial experiments.

The necessity for economy in estate work imposed by the conditions of the last two years has been reflected in the number of enquiries which have been received in regard to manurial practice. In the Annual Report for 1932 the view was expressed that but little risk attached to the use of the cheaper inorganic nitrogenous manures in place of organics, provided these were used in reasonable quantities and combined with a liberal use of green manures. This view was based on the results of the manurial trials laid down at St. Coombs which had then been in progress for two years. The third year of this experiment, completing the first pruning cycle, has confirmed in every way the findings already recorded. Once more no significant difference in yield has resulted when comparing the effect of Blood Meal, Ammonium Sulphate and Cyanamide, nor has any difference in quality been noticeable between the teas treated with organic and inorganic nitrogen respectively. As in the two previous years no effect has been produced by the addition of potash.

The experiment is being continued but the results already obtained, extending as they do over three years, give a very clear answer to enquiries as to the relative effects of organic and inorganic nitrogen and have undoubtedly been of great service to estates and enabled very large economies to be effected by the substitution of cheaper and less complicated manures for the mixtures formerly in use.

There is little evidence, in short, that manures, *when applied in reasonable quantities*, have any effect on quality and this applies just as much to inorganic manures as to organics.

On the other hand, there is no reason to doubt that unduly high nitrogenous manuring of any type, resulting in a sudden forcing of growth, is detrimental to quality; in other words the decisive factor is the *amount* of nitrogen applied and not its kind.

The manurial experiment at St. Coombs has been confined to the question of nitrogen and potash. Recently a similar experiment has been started in the Passara area. Here, however, the effect of phosphoric acid will also be studied as well as the influence of the time of application of the "pruning mixture".

Soil fertility is closely connected with the physical conditions of the soil. The Institute has continually stressed the importance of this question and advocated a greater use of green manures and cover crops. Apart from actual fertility such practice has of course an important bearing on soil erosion. Experiments on the establishment and treatment of bush green manures and cover crops are, therefore, being conducted. The chief difficulty is to find a suitable cover for up-country conditions. A promising species at present being investigated is *Trifolium subterraneum*, the subterranean clover. This has a moderate root system, is drought resistant and has successfully survived a severe south-west monsoon.

Amongst high shade, *Calpurnea aurea*, a South American species, seems particularly promising, while *Hakea saligna* may be useful in wind belts. The latter has been used in South India to supplement *Grevillea*.

Passing on to diseases and pests of tea, the Mycologist, in addition to advisory work generally in regard to fungus diseases and their prevention, has been particularly concerned with the disease known as Witches Broom which in the opinion of many persons is becoming much more prevalent. In this connection, however, there is probably a certain amount of confusion. Accumulated evidence points more and more to the conclusion that the term "Witches Broom" is applied to a variety of symptoms which may arise from very different causes. The term is analogous to the medical term "fever" which describes the condition of the patient but which is by no means of a specific character. Many specimens sent in to the laboratory as Witches Broom cases are not really so and it is, therefore, likely that the increase in incidence is not really as great as sometimes supposed. In spite of such a reservation it must be admitted, however, that on certain estates the "disease" is spreading and is of considerable importance. As has been already pointed out in *The Tea Quarterly* there is a considerable resemblance in many respects between the symptoms of Witches Broom and those of the disease known as Tea Yellows in Nyasaland. Investigation of the latter disease has shown quite clearly that it is produced by a deficiency of sulphur in the soil and can be cured by remedying this condition.

Experiments have, therefore, been carried out by the Mycologist during the past year to see whether Witches Broom is due to a similar cause. It need only be said here that the results obtained indicate that the two diseases are evidently not identical in so much as sulphur treatment has had no beneficial effect on Witches Broom. The specific cause therefore remains obscure. It seems probable, however, that similar symptoms may sometimes arise from such diverse causes as severe wood rot, the very slow attack of a root disease, or the presence of slab rock in the soil or even

from adverse climatic conditions as was seen in the Kandapola district. In the latter case the conditions cleared up quickly when normal weather was experienced.

The main problems facing the Entomologist have been Tortrix and Nettle Grub. In regard to Tortrix attention has been focussed chiefly on biological methods of control, chiefly through the egg parasite *Trichogramma*. The breeding of this parasite on the large scale has presented many difficulties. Most of these have been overcome except the question of cost. Unfortunately this last factor seems likely to be decisive, more particularly as field trials with the parasite have shown that under the conditions so far experienced its efficiency is extremely low. Work which has been proceeding simultaneously in other countries with this parasite has in most cases led to a similar conclusion and it therefore appears probable that other methods will have to be tried.

Work on Nettle Grub has been carried out at the temporary substation in Passara. Wilt is probably the main natural controlling factor, while under artificial measures soap spraying is the most convenient. Success depends on the attacks being dealt with before large areas are concerned. Spraying under these conditions combined with the regular collection of cocoons has greatly reduced both the area attacked and the intensity of such attacks. The pest has thus been checked but by no means eliminated.

As in the case of Tortrix a search is being made for parasites capable of dealing with Nettle Grub. In this connection I may remind you that in 1930 an application was made to the Empire Marketing Board for a grant to finance a comprehensive survey of insect pests and their parasites in Ceylon. Negotiations for such work were well advanced when the closing down of the Board's activities unfortunately prevented such assistance from being forthcoming.

The future of our Entomological work is causing much concern. The agreement of our present officer expires in December and it is clear that this cannot be renewed unless the finances of the Institute are placed on a more permanent basis. No one can contemplate without anxiety, however, any relaxation of entomological research. Not only do the pests to which I have referred require further investigation but there are at least two other problems of outstanding importance to be considered — I refer to Termites and Shot-Hole Borer.

We are fortunate in having in the Department of Agriculture an officer who has made a special study of termites and when the Institute was started it was arranged, and it was in my opinion a most satisfactory arrangement, that work on termites in tea should still be dealt with by Mr. Jepson. I should like to take this opportunity to express on behalf both of the Tea Research Institute and of tea planters in general our appreciation of the extremely successful work which Mr. Jepson has carried out on our behalf. Unfortunately other problems now occupy a good deal of Mr. Jepson's time and it may well be that the Institute will be called upon to take over a portion of this work. Be this as it may shot-hole borer at any rate remains as a problem which in itself calls for the retention of our full Entomological Staff and I sincerely trust this meeting will endorse the view that this should be done.

I now come to the question of tea manufacture. The subject is so wide it is quite impossible for me now to review the work we have carried out.

Detailed investigations have been made and are continuing on every aspect of manufacture. Such work naturally includes a study of the composition of the leaf and the influence on this of season, climate and cultural treatments. Similarly close attention has been given to the conditions of withering, rolling, fermentation and firing and the effect of modifications in these processes on the made tea.

Much of the data thus collected has already been published and valuable recommendations in regard to manufacture were summarised in Bulletin No. 9 of the Tea Research Institute which has I think received wide recognition from the Industry.

I should like to say a word however about future development in manufacturing experiments.

In addition to examining existing processes, it is most desirable that the Institute should be in a position to test out new inventions and processes in tea manufacture. Work in this direction has been hampered by lack of funds as considerable expense on plant and equipment would have to be incurred.

It is hoped however that arrangements will shortly be completed enabling us to commence an investigation of electrical withering. There can be no doubt that withering is one of the least satisfactory controlled parts of tea manufacture and any arrangement that can offer an improvement in this direction at reasonable cost deserves close attention.

The research activities of the Institute lead up to and form the basis of our advisory work. The average number of enquiries received during the year is nearly 2,000 while about 150 visits are annually paid to estates by members of the staff.

In addition, the Institute maintains a special officer for advisory work amongst small-holders. During the past year this officer visited 108 small-holdings and carried out demonstrations on 53 of these. Repeated visits were paid to each village and every effort made to see that methods recommended were actually adopted and tried out. In addition to demonstrations, meetings of small-holders have been held when tea cultivation in all its aspects has been discussed. In view of the success of this work it is intended to appoint next year a second officer to work in another area.

The Annual Report of the Institute for 1933 has just been published and to this I must refer you for details of our other activities.

I believe that the results already obtained are of great value and I am confident that if the Institute is not unduly hampered by lack of funds or other restrictions, the work it can do will be of lasting benefit to the Industry.

FINANCES OF THE TEA RESEARCH INSTITUTE OF CEYLON

JAMES FORBES, (JNR.)

CHAIRMAN OF THE BOARD OF MANAGEMENT (T. R. I.)

THE Tea Research Institute of Ceylon is dependent for its revenue from its estate and from an export tax on tea, and the latter is, of course, the most important source of income. This export tax is fixed at 10 cents per 100 pounds of tea exported by Ordinance No. 12 of 1925, which is the Ordinance which provided for the establishment of a Tea Research Institute.

At the request of those bodies which represent the tea industry this export tax was increased from 10 cents per 100 pounds to 14 cents per 100 pounds tea exported for three years, from January, 1931 until December, 1933, by an amending Ordinance passed towards the close of 1930, and the reason for this request was that the then income was insufficient to meet the essential extensions of the research organisation, and for their proper functioning.

During 1933 a control of exports of tea came into force and for that year curtailed the export of tea from the Island by 15 per cent. of its ordinary normal production, and this, you will appreciate affected the revenue of the Institute considerably. In point of fact the loss of income in 1933 due to restriction for nine months was some Rs. 47,000/-. The Board therefore approached the State Council (having received the assent of the bodies concerned) with a view to having the export tax maintained at 14 cents per 100 pounds for the present restriction period, but this was agreed to by the Council for 1934 only, and the matter is to come up for revision again shortly.

Before approaching the State Council or the Associations interested the Board, realising that the control of exports and its concomitant reduced Cess would seriously affect its revenue, appointed a Sub-Committee to go into the question of finance and re-organisation, and that Committee's report formed the basis of the request for the maintenance of the Cess at the 14 cents rate when application was made to the State Council in December, 1933.

The Planters' Association of Ceylon, the Ceylon Estates Proprietary Association and the Ceylon Association in London, together with the Small-holders' representative on the Board, approved of the report of this Sub-Committee, but the Low-Country Products Association suggested certain amendments which the Board was unable to accept at that time.

Subsequent events have, however, enabled the Board to meet. almost in their entirety, all the then criticisms of the L. C. P. A. and I trust that we shall therefore be enabled to meet the present situation with a united front.

Before going into a detailed statement of the finances of the Institute I must explain that for the purposes of the necessary capital expenditure and purchase of an estate, the Board borrowed a sum of one million rupees from Government in 1925, and this is to be repaid in 25 annual instalments for both capital and interest repayment by a fixed annual sum of Rs. 78,227/-. This is a first charge on the revenue of the Institute and is placed on fixed deposit monthly immediately revenue is remitted by the Treasury. We have been criticised in certain quarters for showing a reserve for redemption purposes in our balance sheet, but this criticism arises from an improper appreciation of the facts. The only reason why any kind of redemption reserve appears in our balance sheet is that the Government financial year ends in September (when our annual payment is made), whereas our financial year ends at the end of December, and hence three months' deposits towards the next loan payment have accumulated.

The Board's financial policy is, (1) to maintain the Institute and Staff at such a level as to enable the work to be carried out with full efficiency and with the maximum benefit to the Industry, including the small-holder; (2) to set aside annually a reasonable sum to cover depreciation of plant, buildings etc., and (3) from revenue to set aside and accumulate a sufficient liquid general reserve to meet future capital expenditure.

No. 1 requires no explanation from me, but I may be permitted to say a few words on the two reserves.

Taking the depreciation reserve first, whilst the Institute was in its infancy it was only possible to make book entries for depreciation, but I think you will agree that successful researches in tea manufacture are almost certain to result in improved factory design and in improved machinery, and it will be necessary for the Institute to lead the way in applying the results to commercial practice. Although the factory and machinery and equipment is of modern design, alterations, additions and reconstructions will be necessary to test out the practical value of discoveries made by research, and for this reason the Board's aim at creating a cash reserve for this purpose must be considered sound finance, and the actual rates of depreciation which have been allowed are, in my opinion, on the low side.

Turning to the General Reserve, the object of this is to provide means for all new capital requirements, and it will be appreciated that the usual channels available to ordinary estate companies for such purposes are not open to the Institute. There are on St. Coombs approximately 65 acres of patna land suitable for opening in tea and capital will be required in 1938, when the existing restriction on opening land in tea are removed, for that purpose. One loft of the factory still requires tats and other requirements will arise though difficult to foresee. It seems probable that it will be necessary as research work progresses, to obtain and experiment with, new types of machines and equipment, and it appears essential that the application to commercial practice of results emanating from research should not be held up for lack of funds for the purpose. An efficient General Reserve is therefore required not only to provide means to supply visible capital requirements, but for purposes which cannot at present be foreseen accurately, and I think you will agree here also that the policy of the Board in this direction is sound.

Turning to the future and our forecasts therefor, we have estimated for the Cess to be maintained at 14 cents per 100 pounds tea exported until the end of 1938 and I am glad to be able to state that the Planters' Association of Ceylon, the Ceylon Estates Proprietary Association and the Ceylon Association in London have all unanimously agreed at recent meetings to the Board's proposal in this connection. We have estimated that the burden of restriction will be gradually lifted, and have taken the figures as 10 per cent. for 1935, 7½ per cent. for 1936, 5 per cent. for 1937 with full crop from April 1st., 1938. Profit from the estate has been placed as at Rs. 20,000/- for 1935 and Rs. 25,000/- for 1936 to 1938. And lastly provision has been made for the retention of the Scientific Staff on existing lines, except that provision has been made for an additional Small-holdings Officer from 1935. The latter expansion was strongly supported in the debate which took place in the State Council last December when the Cess was passed for this year.

With regard to the Senior Scientific Staff, when the 1933 forecast was made it appeared that even with a 14 cents cess it would be impossible to retain the services of an Entomologist, but things have improved, profit from the estate has increased and the probable incidence of restriction lightened, so, although we are without an officer in this department at the moment through the State Council having allowed us the 14 cents Cess for one year only, we have been able to include him in the 1934 forecast without making any additional application for funds to the Industry.

The matter of the retention of an Entomologist has recently received the close attention of the Board, as, by not employing an officer in this department it could carry out a restricted programme of work on a 13 cents Cess from 1935 to 1938, although this would mean a reduction of revenue of some Rs. 94,000/- for the period. Many important pests of tea await investigations, of which shot-hole borer may be mentioned, and after weighing up all the considerations the Board decided that it would be taking an undue risk and lacking in its duty to the Industry if it did not recommend to the bodies concerned the retention of this important link in the administration, and its decision has been unanimously upheld by the main Associations concerned.

Taking the estimates of revenue as accurate as can be framed at the present juncture and maintaining the efficiency of the Institute on economical and sound lines, it is foreshadowed that by the end of 1938 there will be a sum of Rs. 121,000/- available under the heading General Reserve. Of this sum an amount of Rs. 88,000/- for capital expenditure on opening up the estate etc. will be required immediately, leaving a balance of only Rs. 33,000/- for future unforeseen capital expenditure, which cannot be regarded as excessive.

Recently I had the pleasure of escorting the Minister for Agriculture and Lands round the Institute and in course of conversation upon the subject of its finances he asked me for an assurance that in the event of our estimates of revenue not being fulfilled, we would not come to the State Council with a further request, and I was readily able to give him that assurance for two reasons. Firstly, my estimates have been framed with very great care, and secondly, I could not do so without the backing of the Industry, which I would not get.

But on the present occasion I submit that I have outlined to you a policy which is based on very sound financial proposals and which have the unanimous backing of the whole Tea Industry of this Island behind them, and for these reasons I apply for your approval of my application to the State Council that the cess be retained at 14 cents per 100 pounds of tea exported until the end of 1938, whereafter the matter can come up for further revision. In doing so I feel that it is needless for me to stress to a body such as this the absolute necessity of having this matter settled for long periods ahead.

MEMORANDUM ON THE POLICY AND WORK OF THE RUBBER RESEARCH SCHEME (CEYLON)

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DIRECTOR OF RESEARCH,

RUBBER RESEARCH SCHEME (CEYLON)

I am very glad to have an opportunity of submitting to this very representative meeting of agriculturists a short account of the policy and work of the Rubber Research Scheme.

The Research Scheme as at present constituted was established by Ordinance No. 10 of 1930. The Board of Management comprising representatives of the Treasury, State Council, Planters' Association of Ceylon, Ceylon Estates Proprietary Association, Low-Country Products Association, Rubber Growers' Association and Small-holders, under the Chairmanship of the Director of Agriculture, met for the first time in December, 1930, so the Scheme has been in active being for 3½ years.

It may be well to remind the meeting that this period has coincided with the unprecedented slump in world trade and the comparatively even greater depression in the rubber producing industry. When the Ordinance was drafted it was anticipated that the income of the Scheme, derived from an export cess of ⅛ cent per lb. of rubber, would be based on exports of the order of 75,000 tons per annum, representing an income of some two lakhs. As members will be aware there have been times during the past 2 years when the level of production has fallen to barely half this figure and there were fears of even greater curtailment. Thus when the Board of Management came to consider proposals for the development of research it was faced with complete uncertainty regarding the future level of income and wisely refrained from becoming involved in a rapid scheme of development, for which funds might prove to be insufficient. The steady improvement in conditions during the past 12 months has enabled the Board to undertake a modest scheme of development but the recently introduced restriction scheme will again have the effect of curtailing our income.

At the time of the establishment of the present Research Scheme there was a body of the same name in existence, financed partly by voluntary subscription and partly by a *pro rata* contribution from Government, which had carried on research for a number of years. This paper does not include

carried on research for a number of years. This paper does not include any account of the accomplishments of the old Research Scheme. As was intended by those responsible for framing the Ordinance, the old Research Scheme handed over its staff, buildings and other assets to the new Board of Management. The technical staff thus taken over consisted of myself as Chemist, Mr. R. K. S. Murray as Mycologist, and Mr. W. I. Pieris as Agricultural Assistant. These officers have constituted the Staff of the Rubber Research Scheme until this week when it has been augmented by the arrival of an additional Chemist, Mr. M. W. Philpott. The buildings and other assets handed over comprised laboratories and living quarters at Culloden Estate, Neboda and an experiment station of 70 acres at Matugama.

The lines of work which the Research Scheme is intended to deal with are laid down in the Ordinance as follows: " . . . . . in particular the growth and cultivation of Rubber plants, the prevention and cure of diseases blights and pests, the processes for the treatment of rubber latex and the conversion of such latex into marketable rubber and the utilisation, marketing and disposal of rubber and in general of all products derived from rubber plants.

Another relevant paragraph states that "the Board shall, by the provision and publication of information as well as by advice and demonstration and the inspection of plantations, give practical assistance to persons engaged in the rubber industry."

Before discussing the policy of the Research Board in furthering these objects and the progress which has been made up to the present I should like to point out that a small rubber producing industry such as that of Ceylon is faced by as many problems as a major producing country such as Malaya but it is obvious that the funds available for research will be proportionately smaller. It is therefore essential that a small organisation such as ours should concentrate mainly on problems which are of special local importance, while keeping in close touch with work or problems of more general application carried out in larger centres.

It has been necessary for the Board to consider the orientation of research in relation to this principle and also in relation to the economic position of the industry in general and to decide on the extent to which attention should be given to the branches of research usually known as "Production" and "Consumption" research respectively. Realising that Ceylon is behind other producing countries in agricultural work, more especially in regard to the improvement of planting material by budgrafting and selection, it was considered essential that this type of work should be continued and it has therefore been the policy of the Research Scheme to maintain a balance between agricultural research and work on promoting the utilisation of rubber.

The work and proposals of the Research Scheme may now be considered under the following headings:

1. Agricultural problems.
2. Pests and Diseases.
3. The Manufacture and Utilisation of rubber.
4. Advisory services.

1. AGRICULTURAL PROBLEMS

It has been recognised that there is little scope in Ceylon for the extension of the area under rubber by new planting and that attention must mainly be centred on the maintenance and improvement of existing areas and the possibilities of replanting with improved material. The importance of work on budgrafting and selection lies in its relation to replanting.

The Research Scheme has recently purchased Dartonfield Estate, a property consisting of 170 acres of mature rubber near Agalawatte, where it is proposed to carry out field trials on tapping systems, manuring, soil conservation and replanting. All field trials will be laid out on modern lines, which enable the results to be examined mathematically and their accuracy to be assessed. A replanting experiment, covering an area of 7 acres, has been undertaken this year for the purpose of investigating the effect of different methods of clearing the land on the growth of the new stand of trees and the incidence of disease, and the effect of different species of cover crops and methods of control on growth. The area is being planted with budgrafts of 3 proved imported clones.

The Experiment Station at Nivitigalakele, Matugama, (about 5 miles by road from Dartonfield) which was taken over from the old Research Scheme, comprises an area of 70 acres and has mainly been utilised for testing the value of high yielding Ceylon trees as "mother trees" for the supply of budwood; or in other words as a testing station for Ceylon "clones". The procedure adopted is to establish in the field, buddings from high yielding estate trees, which are selected on the basis of yield records supplied by the estate concerned, in conjunction with bark examination and inspection of the trees by a research officer. It is well known that only a small proportion of trees transmit their high yielding capacity to their budded offspring. It is therefore necessary to wait until the buddings reach tappable size and to assess the value of the clone by test-tapping conducted over a period of several years, together with observations of growth and other characteristics. The first buddings at Nivitigalakele were made in 1927 and some 500 trees are at present under test-tapping. Budwood from an additional 200 mother trees of which about 100 are considered to be of outstanding promise, is established in the budwood nursery, awaiting trial in the field as soon as land is available for the purpose. Application has been made to Government for 100 acres of forest land adjacent to the Experiment Station for this purpose and to accommodate plants derived from pedigree seed.

Experiments on plant breeding by artificial cross-pollination of trees of different clones are being undertaken as the trees become sufficiently mature to produce flowers. Up to the present only a few pedigree seedlings have been obtained from local material owing to the immaturity of the trees and interference with flowering by *Oidium*. Experiments have also been undertaken at Nivitigalakele on the technique of budding and the after-treatment of the budded plants, and provision is made for giving instruction in budding to estate employees.

A nursery was established in 1932 to provide material for the distribution of budded plants of proved clones to peasant proprietors at a nominal price. The nursery is at present being budded and several thousand plants will be available for distribution, either this year as dormant

stumps or next year as grown stumps. The position regarding issue of the plants will be somewhat complicated by the provisions of the Restriction Scheme. It is also proposed to cater for the supply of material to small capitalists when facilities are available for planting more extensive nurseries.

During the past 2 years considerable interest has been taken in tapping systems and a number of estates have adopted various modifications of a system under which 2 half-spiral cuts are made on opposite sides of the tree. In the absence of facilities up to the present for starting our own field trials of the systems the Research Scheme has kept in touch with the subject by means of observations on and reports from estates. A questionnaire was issued last year and resulted in valuable information being received from 82 estates. A report on the subject was published in the Scheme's *3rd Quarterly Circular* for 1933 and a further questionnaire has just been issued. The Research Scheme is collaborating in two estate experiments designed to compare one of the systems with alternate daily tapping and it is hoped to initiate a comprehensive tapping experiment at Dartonfield within the next few months. It should be mentioned that it will take a number of years to make a final assessment of the merits of different systems.

2. PESTS AND DISEASES

The subject which has received most attention under this heading since the inauguration of the Research Scheme is the leaf-fall caused by *Oidium Heveae*. This disease, which was first reported in Ceylon in 1925, has caused comparatively little damage in low-country districts until the present wintering season but at mid-country elevations, where climatic conditions are favourable to the fungus, it has caused widespread damage on a steadily increasing scale.

The Research Scheme collected information on the distribution and effects of *Oidium* by means of questionnaires in 1928 and 1929. In the latter year an experiment was undertaken in the Matale district to ascertain the effects of manuring in preventing the disease. Two heavy applications of nitrogenous and potassic fertilisers were given to the experimental areas but the results in preventing leaf-fall were entirely negative. A trial was also made of liquid spraying with a soluble sulphur mixture but this treatment was replaced in the following year by dusting with fine sulphur powder by means of a portable motor dusting machine. Trials have now been made in 5 successive seasons and the conclusion reached that most of the defoliation can be prevented by sulphur dusting. The treatment is reasonably inexpensive and is considered to be suitable for adoption on an estate scale, in spite of certain practical difficulties.

Future work on *Oidium* is to be discussed at the next meeting of the Research Board but in the meantime it may be said that the main requirement at the present time appears to be to familiarize producers with the recognised method of control, by means of demonstrations in different districts. Improvements in the technique of the dusting operation can best be studied in collaboration with estates undertaking routine dusting operations.

Other subjects which have received the attention of the Mycologist relate to the incidence of *Fomes* in replanted areas, the occurrence of a disease caused by a *Phytophthora* on young budgrafts, the disinfection of

imported planting material, sun-scorch of budgrafts, the prevention and treatment of disease at the point of union of buddings etc.

3. THE MANUFACTURE AND UTILISATION OF RUBBER

I will not take up much time in dealing with the position in regard to normal methods of rubber manufacture. As a result of work carried out by the old Research Scheme and in other countries I think we are in a position to supply any information required by estates relating to ordinary methods of manufacture. About the time the present Scheme was established the subject of smokehouse design was investigated and proposals made which enabled considerable reductions to be made in the amount of firewood used for smoking. There have been numerous enquiries on this subject during the past year and a series of smokehouse plans, suitable for dealing with varying outputs, is at present being drawn up. Trials of a similar type of building for drying crepe with warm air have been made in view of the serious trouble with mould which occurs in many factories where the crepe is airdried. The experimental factory which is to be erected at Dartonfield will include a model smokehouse and crepe drying house and will enable sound methods of manufacture to be demonstrated to producers.

The most important problem facing rubber producers at the present time is to increase the consumption of rubber to bridge the gap between present world requirements and potential production. I have explained in a previous section that there are reasons in connection with the Ceylon industry for the continuation of agricultural research but having made provision for this it is essential that the resources of the Research Scheme should be directed to work tending to promote the increased utilisation of rubber. I have used the words "promoting the utilisation of rubber" in preference to the more popular expression "finding new uses" because they have a definitely wider significance. Research on the utilisation of rubber can be divided into two distinct branches.

1 DIRECT RESEARCH ON NEW USES

This type of research must usually be carried out by those in close touch with the requirements of the industries in which it is proposed to extend the use of rubber and it is therefore necessary, generally speaking, that such work should be done in the manufacturing centres of the world. This type of team-work research on new uses is being carried out on a large scale under the aegis of the New Uses Committee of the Rubber Growers' Association by Rubber Technologists working in conjunction with the Research Associations and individual manufacturers of the industries concerned, in relation to rubber roadways, rubber in paint, rubber in automobiles, rubber in the electrical, engineering and chemical trades, rubber in the printing trade, rubber resins, deodorisation of rubber etc. Information copies of reports on the investigations are received by the members of the Rubber Research Board.

2. The other branch of research on the utilisation of rubber relates to improvement of the properties of raw rubber with a view to providing a more suitable material for existing and new uses. The R.G.A. New Uses Committee has recognised that this is equally as important and profitable as direct "new uses" research in stimulating consumption.

One of the aims of this class of work is to provide a material which can be more easily manipulated by the Manufacturer and thus encourage the use of raw rubber in place of "reclaim" and other raw materials. The preparation of raw rubber in alternative forms such as ammoniated and concentrated latex, crumb and powdered rubber etc. is also within the scope of this branch of research.

While it has been made clear that research on "New Uses" can most profitably carried on in manufacturing centres, it is equally clear that work on the improvement of raw rubber and the provision of suitable grades for new uses must be dealt with by Research Associations in rubber producing countries, working in collaboration with those who know the requirements of users and can assess the suitability of new types of raw rubber for different purposes. The London Advisory Committee for Rubber Research (Ceylon and Malaya) has carried out research on the properties of raw rubber for some years and the R.G.A. New Uses Committee, in developing its campaign, has relied on the Advisory Committee to continue this work in conjunction with the Research Institutes in Ceylon and Malaya. The London Advisory Committee may be regarded as providing the necessary liaison between the two branches of research on the utilisation of rubber.

The general policy of the Research Scheme up to the present in promoting the utilisation of rubber has been to contribute (equally with the Rubber Research Institute of Malaya) to the expenditure of the London Advisory Committee and to co-operate in its work by providing samples of raw rubber prepared under conditions likely to result in improved properties, for trial at the Committee's laboratories at the Imperial Institute, London. The main lines of work carried out by the Committee relate to improvement of plasticity, the preparation of rubber in crumb form both by mechanical and chemical means, critical investigation of the claims made for "reclaim" as an alternative to raw rubber, concentration of latex by creaming and by evaporation etc. A number of patents arising from the work have been taken out in conjunction with the Rubber Producers' Research Association, in order to protect the processes concerned for the free use of the industry.

While research on the utilisation of rubber can be separated into the two branches referred to, these are not to be regarded as watertight compartments. For example the London Advisory Committee, while adhering to its general policy, has incidentally developed a relatively inexpensive type of rubber flooring and is trying to interest manufacturing firms in the product. There are also certain directions in which direct research on new uses can profitably be carried out in rubber producing countries. An example which is of special interest to Ceylon is the possibility of coir residues and other fibrous materials being successfully bonded with latex to form materials for flooring and other purposes. Other examples, on which work has already been carried out by the Research Scheme, are the preparation of self-vulcanizing crepe rubber by the addition of suitable chemicals to latex, and the treatment of jute hessian with vulcanized latex to provide an improved packing material for raw wool. In the latter case however, it is feared that the treatment would not prove profitable at the present price of rubber.

The Rubber Research Board decided last year to extend the scope of its "consumption" research by the appointment of an additional Chemist. Mr. M. W. Philpott, who has had valuable experience of similar work in England, was selected for the post and arrived in Ceylon in May. It is proposed that the Director of Research will continue to work on the improvement of raw rubber by modifications in methods of preparation and that Mr. Philpott will give his attention to such new applications of rubber as can suitably be investigated locally and to investigation of the scope for local manufacture of vulcanized goods, especially such as can be made direct from latex or are associated with the use of other local raw materials. He will be provided with a Laboratory at Dartonfield Estate, and space and equipment will be available in the experimental factory for large-scale trials of the processes concerned.

4. ADVISORY WORK

Advisory work forms an important feature of the Research Scheme's activities and, as I indicated in an earlier paragraph, is specially provided for in the Ordinance. Correspondence with estates and agencies during the past 2 years has averaged 60-70 letters per month and it is encouraging to note that Ceylonese Proprietors are making increasing use of the services of the Research Scheme in this direction. Advisory visits to estates are also made when required. Although this work occupies a material part of the technical staff's time it is a direct service to Producers which appears to be appreciated and enables close touch to be kept with the requirements and views of the industry.

Publicity is given to the work of the Research Scheme by means of an Annual Report and Quarterly Circulars, which are issued without charge to the Proprietors, Superintendents and Agents of local estates who apply for their names to be registered, such registration being renewable annually. At the present time approximately 300 estates are on our publications list, a figure which indicates that there are still many local Producers who do not receive the information made available by the Research Scheme.

There is one type of local Producer who is not in a position to benefit by the publications of the Research Scheme, namely the Small-holder or Peasant Proprietor. Broadly speaking it is correct to say that the small-holder will benefit equally in the long run with other classes of Producer from any improvement in the industry as a result of scientific research but it is desirable that measures should be taken to make information and advice available to the small-holder in a suitable form. This matter has not been overlooked by the Research Board but it has been necessary to postpone consideration until the lines of policy in other directions had been settled. I am authorized by the Chairman to say that proposals in regard to catering for the needs of the small-holder will be submitted to the Board for consideration in the near future.

In summarizing this paper I would say that the policy of the Research Scheme as at present defined is to maintain a balance between "production" and "consumption" research and that the requirements of the work are being catered for at Dartonfield Estate to the extent of the funds available

REVIEW OF THE ACTIVITIES OF THE COCONUT RESEARCH SCHEME OF CEYLON

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THE Coconut Research Scheme is the youngest and smallest of the three Institutes devoted to the three major crops of Ceylon; the Ordinance establishing the Scheme was passed in December 1928, and the Board of Management held its first meeting on April 17th, 1929. During this year the Estate Selection Sub-Committee inspected a large number of estates and made a preliminary selection. The final selection of Bandirippuwa, the location of our station, was made in 1930. During 1930 also staff appointments were made of a Director, Geneticist and Technological Chemist, the latter undertaking a study course in England.

Unfortunate delays beset the Scheme over the purchase of Bandirippuwa Estate and the Board did not take possession until January 7th, 1931. The Director resigned in May, 1931 and the Geneticist took charge of the Estate and was the sole officer of the Scheme until my arrival in October 1931. I assumed charge as Chief Technical Officer on January 1st, 1932, which arrangement is still in force.

Building operations on the Staff bungalows were commenced in November, 1931 and these were finished by the end of 1932. The Laboratory block was not finished until March 1933 when it was opened by the Hon. the Chief Secretary.

Until October, 1932 the clerical and accounting work of the Scheme was carried out at Peradeniya by a Secretary who was shared by the Rubber and Coconut Research Schemes. This arrangement was terminated in October 1932, when the Secretary left the service of the Schemes, and the office was transferred to Bandirippuwa, where the work is carried on under the supervision of the Chief Technical Officer.

Other Staff.—The Soil Chemist was appointed on July 1, 1933. Technical Assistants to each of the three officers were appointed at the end of 1933.

It is clear then that up to March of last year little but preliminary work could be expected of the Scheme, as the Geneticist and myself were the sole officers of the Scheme and had no laboratory facilities. During this time, however, much useful field work was commenced by the Geneticist and we were able to do a good deal of Estate visiting. I am aware that criticism has been expressed in some quarters that the Scheme's Staff do not now visit estates with sufficient frequency. This is, I am afraid unavoidable. Besides the administration of the Scheme I am responsible

for the Technological Chemistry Section, and find it necessary to spend as much time as possible in the laboratory, to do a little to meet the demand "Try to find new uses !" "Something practical". The Soil Chemist, too, is well occupied with laboratory work and field work on Bandirippuwa Estate and lacking a car, is unable to do as much visiting as he would like. The Geneticist, therefore, does the bulk of visits to Estates and always has a full programme.

In reviewing the work of the Scheme to date it will be as well to consider first some results of genetical work, since, as has been mentioned, we were able to commence these fairly early.

Summary of Work done by Geneticist's Department.—The work of the Genetical Section of the Coconut Research Scheme is concerned with the improvement of the Coconut palm as an agricultural crop with a view to cutting down the costs of production and obtaining the highest returns in the way of increased yields.

There are two accepted methods of plant improvement adopted by geneticists. Firstly, the method of isolating types for particular, desirable characters and seeking to combine these characters by the process of hybridisation, and secondly, the method of selecting and propagating desirable types already in existence in plant populations. The two methods could be combined in various degrees.

The former method, that of seeking to effect new combinations of desirable characters by hybridisation, is resorted to in the breeding of annual plants with great success. Here, a large number of generations could be raised in a few years and the results of artificial crossing could be tested in a comparatively short space of time. But when it comes to the breeding of perennials like tea, rubber and coconuts, the method of hybridisation as a means of plant improvement is very slow and uncertain. And with such crop plants the best results are obtained in the shortest space of time by the second method, that of selection and propagation of selected types.

With such a crop plant as the coconut palm, the method of selection is full of promise. In Ceylon the coconut palm is said to be cross-pollinated and more or less self-sterile. Whether this is so or not, it is well known that a population of coconut palms is composed of a number of widely different types. Differences are observed in such characters as earliness, height, length of leaves and bunch stalks, shape, size and colour of nuts, number and weight of nuts, resistance to disease and climatic changes, and so on. As regards earliness, some varieties of palms come to maturity in three years, whereas other varieties may take as much as ten years. Height may vary from five to ten feet in the case of dwarf to 45 feet in twenty years in the case of tall palms. The length of the fronds may vary from 142 inches to 244 inches. Similarly the length of bunch stalks may vary between 13 inches and 28 inches. The shape of the nuts too varies enormously. The number of nuts may vary from three or four nuts per annum up to 300 nuts per annum. And in the same manner, the size and weight of nuts may vary between such limits as correspond with 750 nuts per candy of copra and 1,600 nuts per candy.

Thus it will be seen that there is a wealth of material for which desirable types could be isolated.

And so the work of the Geneticist up to the present has been concerned mainly with the isolation and study of desirable high-yielding strains, selected according to traditional methods adopted in such work. Such selection has been carried out at Bandirippuwa (as mentioned above, some of the first work to be initiated) and on a number of estates situated in the North-Western and Western Provinces, the main coconut growing regions of the Island, and it is proposed to extend the work further as opportunity arises.

The results of the investigations carried out to date are very promising. It has been possible to isolate types yielding up to 7 candies of copra per acre, which compares very favourably with the usual output of 2 or 3 candies on average estates.

The next problem is to ascertain to what extent these characters of high yield are inherited in future generations. This can only be done with the co-operation of landowners who have spare jungle adjoining their estates. One estate owner has very kindly volunteered to place at the disposal of the Scheme a small block of jungle land on which would be tested the second generation of palms obtained from mother trees selected and studied nearly three years on one of his estates.

Similarly, another planter has agreed to plant up twenty acres of land with seed nuts from selected mother palms which will be studied closely both for yield performance and other characters, so that when the daughter palms come into bearing they could be compared with the mothers. Such studies as these, carried out under ordinary conditions of estate management, will help in no small measure to unravel the mysteries connected with the inheritance of that most elusive character—Yield.

In this connection it must be mentioned that the most reliable work of this nature could only be carried out on land belonging to the Scheme and under the absolute control of the Scheme. Private landowners cannot be expected to undertake experiments from which they may or may not obtain favourable financial results, and they can in no case be expected to surrender to the Scheme any rights that they may possess over their land. And so it is of the utmost importance that the Scheme be allowed to purchase a portion of good jungle preferably in the North-Western Province, situated not more than 30 miles from the estate belonging to the Scheme. This land will be devoted mainly to the propagation of desirable strains and genetical studies concerned therewith, and will in time become a Central Seed Farm able to supply guaranteed seed nuts for new plantations or for the replenishing of old estates.

There are some extensive areas of very good jungle situated near Madampe viz. Panirandawa and Elapahalakelle, and it is hoped that the Scheme will be able to purchase a small block from either of these places.

Varieties of Coconuts.—In Ceylon, as far as one is aware, the large majority of plantations are stocked with only a few varieties. In general it may be said that the tall forms predominate and in most cases are almost exclusively grown. These tall forms perhaps correspond to the comprehensive Laguna type of coconut grown in the Philippine Islands.

A few estates have commenced the cultivation of other (usually imported) varieties on a small scale. Thus the landowner has a small field on one of his estates where he is growing 6 supposedly different varieties of

coconuts imported originally from the Philippine Islands. And again, another estate is known to us where they have a fair number of green dwarf palms, which too must have come from the Philippine Islands or the Malay States.

It is conjectured that there are about 35 distinct varieties of coconuts, some of which are of great economic importance. Of these varieties, besides the tall forms, the most extensively cultivated types are the green, yellow and brown dwarfs. And it is said that the dwarf forms are not only earlier maturing than the taller, but also give 20 per cent. more copra per acre.

Thus it is seen that a good deal of attention will have to be paid to the study of the different varieties of coconuts in relation to their economic importance.

A start has been already made in this direction on the estate above-mentioned, but it is obvious that for a detailed systematic investigation on these lines representatives of the different varieties will have to be grown in fair numbers on land belonging to the Scheme. Here again the need for a piece of jungle land is great.

Biometrical Studies.—In addition to the work of isolation of desirable strains, briefly mentioned above, a fairly extensive biometrical study of the coconut palm has been made in connection with the relation of the measurable characteristics of the coconut palm with yield. Some results of these studies have been published by the Geneticist in the form of a paper entitled "Studies of the Coconut Palm I" which appeared in the second number of Vol. 82 of *The Tropical Agriculturist* (February, 1934). A number of very interesting correlations have been worked out in that paper, and some useful hints are given therein regarding the selection of good mother palms. Special mention should be made of the very high correlation between the weight of husked nuts and weight of copra obtained from these nuts, which come out to $+0{\cdot}96$. Further a simple mathematical relation seems to hold between the weight of husked nuts and corresponding weight of copra, in that the latter is equal to approximately $\frac{1}{3}$ of the former. With over-dried copra this relation will naturally be slightly different.

Studies on Germination of Coconuts.—A number of investigations have been carried out in order to test the traditional ideas held by planters on the selection of seed nuts and general nursery technique. The results obtained so far can briefly be summarised as follows:

If quicker rate of germination and sturdier seedlings could be taken as standards of superiority, then

1. Nuts obtained from the oldest ripe bunch are better for seed than nuts obtained from the second or younger bunch. This holds good whether the nuts are green or dry (dead ripe).
2. There is no special virtue in lowering seed nuts to the ground by means of a rope, if they are in a fully ripe condition. If they are not, they should not be used for seed.

Further experiments are being carried out to ascertain the best position in which the seed nuts should be placed in the nursery.

Since nursery management is of the utmost importance in laying down plantations, these experiments and others on similar lines have an important bearing on agricultural practice.

Passing on to the Department of the Soil Chemist, although this officer was only appointed in July last year, his work is already developing. Like other investigations it falls under the following heads: (1) Immediate Research, (2) Long range Research and (3) Advisory Work.

Immediate Research.—This represents urgent problems that need immediate investigation, and demand a prior claim on the Soil Chemist's programme of work. The most important of these consists of accurate field experiments on manuring and cultivation.

Accurate field experiments on statistical lines have not been carried out with coconuts.

Fortunately he has been able to draw much useful information upon careful individual tree records initiated in 1931. In this connection I must refer to the invaluable advice of the Agricultural Chemist of the Tea Research Institute. Dr. Norris has already mentioned how in the early days of their Institute they had to devote much attention to studying the technique of field experiments—much of their experience has been of great use to us. The yield records of two years of 300 trees on our estate have been statistically analysed as a uniformity trial and results obtained show that a 20 tree plot is the most desirable. The information could have been obtained in no other way. We are now in a position to lay out experimental blocks.

The special points that need examination are (1) the effect of nitrogen, potash and phosphate in the form of artificial manures, alone and in various combinations (2) organic versus inorganic manures, regarding which there seem to prevail much controversy (3) the comparative effects of various cultivation operations such as ploughing, disc-narrowing, mulching with coconut husks: but considering the labour involved in accurate field experiments a beginning can only be made with the first.

As cattle are not kept on the Scheme's Estate, it is proposed to make arrangements with a neighbouring estate to carry out a co-operative field experiment on cattle manuring. Such an arrangement is further necessary, as it is felt that the presence of cattle may interfere with the control of experiments on artificial manures. It must be remarked that there are considerable difficulties in the design of statistically sound experiments where the individual variation of the animals have to be considered in addition to the already accumulated errors of soil heterogeneity and plant variation.

Yield Basis.—The yields of manurial experiments must be referred to copra, and at the outset of our experiments it will probably to decided to weigh copra from the different blocks. We consider it likely however that the high correlation referred to between weight of husked nut and weight of copra will enable us to shorten the operations pretty considerably.

A chemical study of the value of cattle and buffalo manure will be presently commenced, as also an investigation into the changes that occur in the usual practice of manuring with cattle in trenches round trees.

The Scheme has been criticised in some planting circles for lack of attention to the problems presented by green manure and covers. We have never hesitated to recommend suitable crops for these purposes, but do not lose sight of the fact that exact information particularly concerning fertility as apart from improvement of soil texture, is not available for coconuts. No data appear to be available in the literature showing the relation of green manuring to crop yields, and in view of the diversity of controversial points about various aspects of green manuring, a comprehensive study can only be made by co-operative experiments in various districts under different climatic conditions. Later on it will be possible to carry out a green manure survey, first with the aid of a questionnaire, and subsequently study local problems on establishment, dieback, drought resistance, nitrogen fixation, nodulation and methods of disposal in relation to soil and climatic types. With the limited assistance available it will be too ambitious to commence such a comprehensive investigation, but with the co-operation of planters it will be possible to help a lot towards a general understanding of these problems.

Among other urgent problems the following are kept in view, and will be taken up as exigencies permit: (i) A critical study of cattle keeping on coconut estates, particularly in the chemical and manurial aspects. (ii) Pasture and fodder problems of coconut estates, especially the possibility of cultivating fodder crops such as *Trifolium subterraneum*, Lucerne, Sweet Clover, Berseem, and other exotics, as also the exploitation of indigenous fodders such as Desmodiums. Already demonstration plots of two varieties of Desmodiums have been grown. (iii) The manurial and soil fertility aspects of catch crops, which will be studied in co-operation with the Geneticist when the jungle block is available. The growing of catch crops have been an acknowledged system in opening up coconut lands, but how far it affects ultimate yields when viewed at a long range have to be critically studied.

A chemical study on the utilisation of coconut husk, coir dust, and coconut water as manures on the estate has already been commenced. In view of the fact that it is a practice among some estates to burn the husk and use the ash as a potash manure, several samples of such ash sent by estates have been analysed, and a study of the potash content of the husks burnt under controlled conditions have been made. Experiments will be made on the composting of husks, and the chemical changes which occur when husks are buried in trenches.

Fibre Dust.—A fairly comprehensive examination of fibre dust the most noticeable of all the by-products of the industry has been made in both the Soil Chemist's and Technological Chemist's Laboratories. From theoretical considerations based upon complete analysis for lignin, pentosans, cellulose, moisture and ash, it seems that this material is likely to be highly resistant to decomposition for the preparation of compost. Laboratory experiments to prepare a compost with the addition of such materials as Adco, Ammonium sulphate, etc., confirm this and it may prove necessary to abandon this line of investigation.

While on the subject of coir fibre dust it might be mentioned that one possible application is in combination with rubber and some interesting

preliminary work has been carried out in collaboration with the Rubber Research Scheme. The chief problems are :

(i). The non-adhesion or wetting of the particles by rubber latex. This was solved by Mr. O'Brien.

(ii). The improvement of the colour of the material which we have in hand.

Long Range Research.—There are several problems on which a long view has to be taken, the conclusive results of which will not be immediately available. These relate specially to fundamental problems, but it is in their elucidation that practical problems have to be solved. These are briefly summarised merely to serve as an indication of the possible and necessary lines of development for the future: (a) Correlation between chemical analyses and manurial trials, based on analytical data that will accumulate as time permits during the progress of the field experiments. (b) Soil Survey and classification. It is impossible to organise a comprehensive soil survey immediately, however, desirable this may be, but samples during the course of advisory work will serve as the basis for a preliminary soil survey. (c) Physiology and Nutrition of the coconut palm. Material has been collected for the chemical study of the development of the husk, shell, kernel and water of the coconut up to maturity in collaboration with the Technological Chemist. (d) Microbiology of green manures, compost, etc. This may even be classified as an urgent problem, but at present, however, important it may be, there is no likelihood of the work being commenced. (e) Study of the root system of the coconut palm in collaboration with the Geneticist. (f) The irrigation of coconut land under semi-arid conditions.

Advisory Work.—Considerable time is at present taken up in advisory work which has involved analysis of samples of manurial value. While advisory work of a consultative nature on manuring and related problems would fall within the legitimate duties of the Soil Chemist, there is the possibility that such routine analysis which take up considerable time, will seriously interfere, with the main work, which involves research into problems of general interest to the coconut industry, and it may be necessary for us to define clearly the conditions under which we will agree to examine samples.

I may conclude with a few remarks on some of the more important chemical investigations done and proposed.

Chemical Work.—Of the local uses for coconut oil most susceptible of early development, the manufacture of soap seems to be the most promising. The Registrar-General's Department in response to a request by the writer circularized local manufacturers of soap and has furnished the Scheme with particulars of the extent of manufacture of local soaps and with samples of most of them. The analysis of these samples is nearly complete and it is hoped shortly to issue a bulletin containing them and some recommendations on local soap manufacture.

The low price of nuts has again brought up the question of the production of sugar from sweet toddy. Sweet toddy compares favourably with sugarcane and beet sugar juices in sugar content and is superior to the latter in that it contains less foreign matter in proportion to the sugar. I have estimated from average yield figures that an acre of coconuts would

yield $2\frac{1}{2}$ tons of crude sugar, which is of course considerably less than that given by an acre of sugarcane. The point that needs most consideration is cost of collection; the actual cost of tapping and collecting would determine the possibility of economically producing sugar from the coconut palm and these are certainly prohibitive under present circumstances. On Bandirippuwa we have commenced tapping and have a license for twenty trees. Facilities are not available however for more than analytical work.

Coconut Charcoal by-products.—Coconut charcoal is one product of the coconut, the demand for which seems to exceed the supply. 100 lb. of shell (about 470 halves) give about 30 lb. of charcoal. Results obtained here by condensing as much as possible of volatile matter lost in charcoal burning are very similar to those obtained by other research institutes in India, Malaya and the Philippines. 100 pounds of undried shells gave thirty pounds of charcoal, 38·9 lb. of pyroligneous liquor, and 4·6 lb. of settled tar. From the tar were isolated carbolic acid and creosote. The residue from the tar even after distilling 80 per cent. of volatile products remains a viscid liquid and is apparently unsuitable for roads, etc. Acetic acid and methyl alcohol are recoverable from the liquor and it might be worth further inquiry whether larger scale experiments are desirable.

Conclusion.—The coconut industry as practised on the estates stops short at copra and, in some cases, fibre. Some factory problems, however are being referred to us and should these increase and should the laboratory experiments such as those on soap and on coir fibre products (of which I have left myself no time to speak) become promising, it will become necessary in the future to consider the provision of accommodation at least for semi-works scale plant, since the transference of problems from a laboratory to a works scale is always a difficult problem in industry.

The Scheme can be of increasing use to the Industry as it gets into its stride and I trust that this address will enable you to give a partial answer to the rhetorical question, recently asked at a public meeting: "What use has the Scheme been to you ?".

DEPARTMENTAL NOTES

THE TOBACCO STEM-BORER (PHTHORIMAEA HELIOPA LW.)

A PRELIMINARY NOTE

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GOVERNMENT ENTOMOLOGIST

AND

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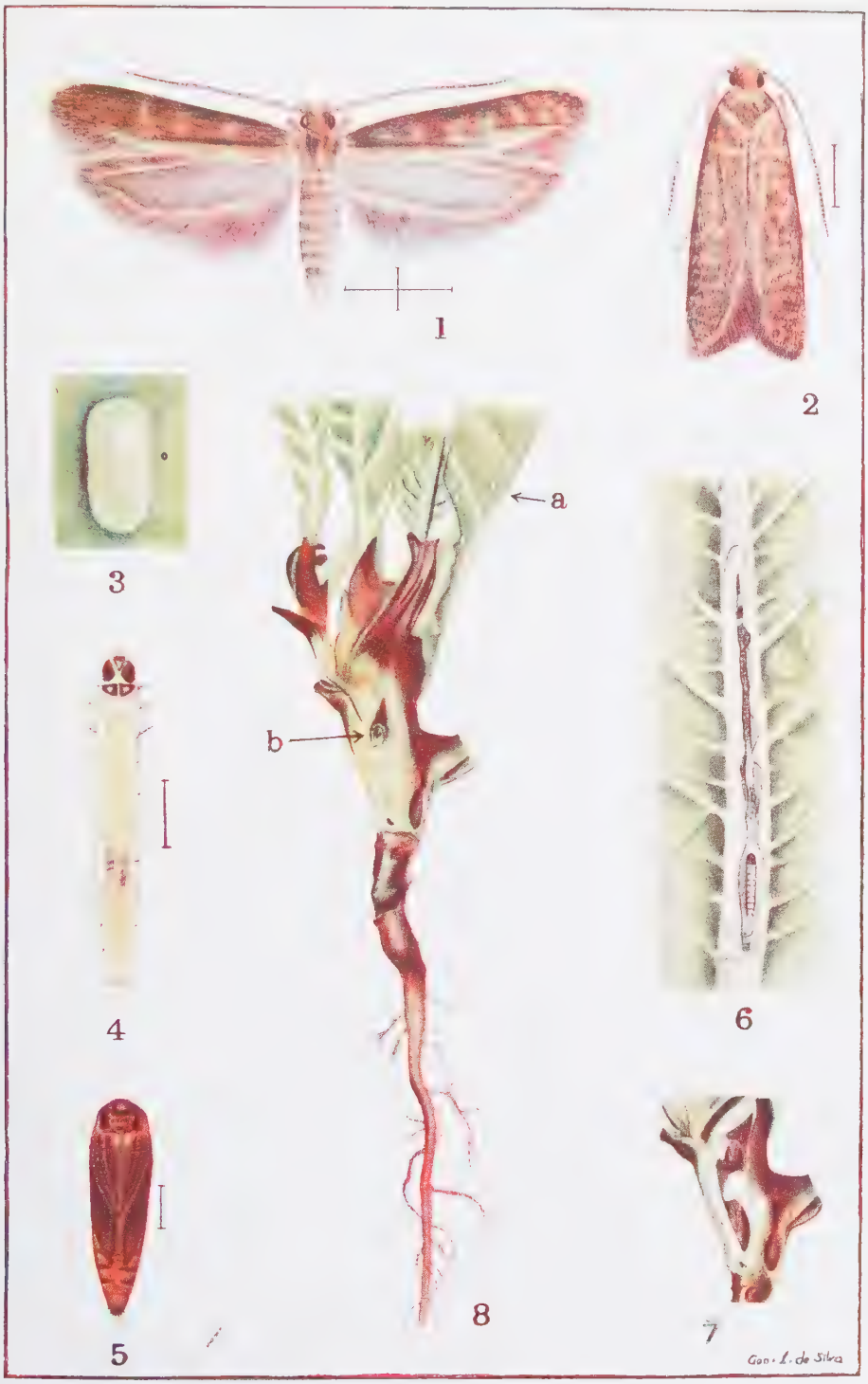
THE stem-borer is probably the most important insect pest of tobacco in Ceylon and occurs wherever this crop is grown in the Island. This insect has also been recorded as a pest of tobacco in many other countries, including Greece, Turkey, Palestine, Southern India, Burma, Malaya, Dutch East Indies, Philippines, Fiji, Australia, East and South Africa. Apparently it is not known to occur in North and South America and the West Indies, its place being taken by a related species (*Phthorimaea operculella*), the tobacco leaf-miner or split-worm, otherwise known as the potato tuber-worm, which is found in some of the other countries along with the stem-borer.

HABITS AND LIFE-HISTORY

Moth.—The insect which does the damage is the caterpillar (fig. 4) of a small brownish moth (figs. 1 and 2). The moths hide during the daytime and occasionally fly out when disturbed; they are active at night when the eggs are laid. In captivity the female moths, after mating, begin egg-laying within 3 to 8 days after emergence, and the oviposition period lasts from about 1 to 2 weeks in the case of normally healthy moths. Such moths, kept in breeding cages, laid between about 50 and about 150 eggs, and it was found that they usually laid the great majority of their eggs during two consecutive nights about the middle of the oviposition period. It is not unlikely that they may lay a larger number of eggs under natural conditions in the field.

Egg.—The small long-oval, soft, pale-green to whitish eggs (fig. 8a) are laid on either side of the leaves of young seedlings, but more often on the upper surface, and may be seen as minute shiny spots. In the case of older plants some of the eggs may be laid on the stem. The eggs turn yellowish before hatching in about 4 to 6 days. A single egg, much enlarged, is shown in figure 3.

Larva.—The newly emerged larva usually wanders about for a short time on the leaf surface before entering the leaf tissues and feeding as a leaf-miner for a day or two. On reaching a side vein the larva burrows



The Tobacco Stem-borer (*Phthorimaea heliopa* Lw.)

1. Moth, wings spread. 2. Moth, resting position. 3. Egg × 20. 4. Full-grown larva. 5. Pupa, removed from tunnel. 6. Portion of tobacco leaf with section of midrib exposed to show larva in its tunnel. 7. Portion of tobacco stem with emergence hole (see 8b) cut away to expose parts of two pupae in tunnel. 8. Infested tobacco plant showing eggs on leaf at *a* and swollen stem with emergence hole at *b*.

Figures 6, 7 and 8 natural size; the lines near other figures indicate natural size.

into this and makes its way gradually towards the midrib which it enters. If the egg is laid near the midrib the larva usually bores directly into this. In any case, within about 1 week after hatching, the larva has passed along inside the midrib and leaf-stalk down into the main stem, leaving a trail of excreta behind it in the gallery. If an egg is laid on a stem the larva usually bores straight into the stem. Often the first indication of an attack in a young plant is the bunching together of the central leaves to form a "rosette"; then the stem gradually becomes swollen and stunted (fig. 8), unless the plants are making a vigorous growth. The more heavily infested plants fail to develop normally and may become subject to various diseases. Plants which escape attack in the seed beds may become infested soon after transplanting and before they have recovered from the shock of removal; in such cases the weaker plants usually fail to survive. In older plants with well-developed leaves some larvae may pass through their whole development in the leaves, mostly in the fleshy midribs (fig. 6). Older plants of the hardier varieties may grow vigorously and produce a more or less normal crop in spite of a heavy infestation consisting of several larvae in the main stem and one or more larvae in every leaf.

The caterpillar is full-grown (fig. 4) in about 24 to 30 days, but some larvae may take a few days longer to complete their development.

Pupa.—The full-grown larva changes into the pupal stage inside its tunnel either in the stem or in the midrib of a leaf, sometimes enlarging a portion of the gallery to form a small chamber. The larva, before pupating, prepares an exit for the emergence of the moth, leaving only the epidermis as a thin, semi-transparent, pale circular spot, at which the emerging moth can break through. Occasionally, the larva makes a hole to the outside, perhaps accidentally, and closes this with a few threads. Under Ceylon conditions no definite cocoon has been observed, as mentioned by investigators in some other countries, but sometimes the pupal chamber, if constructed, may be lined with a few loosely woven threads. The larva then changes into the small brownish pupa (fig. 5), which can often be found by carefully slicing away the emergence spot on the stem (fig. 7b), or on the midrib of a leaf. The pupal period occupies about 10 to 11 days in the breeding cages.

The life-cycle from egg to moth lasts from about 5½ to about 7½ weeks under insectary conditions at Peradeniya, but may be shorter under natural conditions in the field.

In districts where tobacco is grown regularly and where uncultivated tobacco plants are available at other times, it is not unlikely that the stem-borer can breed all the year round with overlapping generations. The fact that the moths are almost invariably in evidence at the beginning of a tobacco season seems to suggest also the possibility of alternate host plants, such as other cultivated *Solanaceae* or related weeds, but so far none has been found.

CONTROL MEASURES

These fall under two main headings, preventive and remedial:

Preventive Measures.—The only preventive measure tried so far is the covering of the seed beds with cloth screens which can be protected from the damaging effect of heavy rains by the ordinary shade canopy of plaited

coconut leaves or "cadjans". The cloth covers should be opened up at the sides during the day and fastened down again before dusk so as to keep out egg-laying moths. The use of these screens has definitely reduced the infestation of stem-borer in the nurseries.

Apart from this mechanical method of control, there are certain insecticidal measures which are worthy of extended trial, with the object either of preventing infestation or of checking an attack in its early stages. For instance, by exposing a suitable liquid poison bait around the seed beds, it might be possible to attract and kill the moths before they lay their eggs. Such a bait would have to be put out at the time of sowing the seed so as to try and attract the moths which come along as soon as the seedlings germinate. If this method proved effective, it should help to reduce the severity of early infestation. Another possible way of minimising the initial attack would be the application of an insecticide to the seedlings with the object of killing both the eggs and any emerging caterpillars which usually wander about on the leaves before entering the leaf tissues. Spraying should be started as soon as possible after the plants appear above ground and be repeated at frequent intervals during the early stages of growth until transplanting. Preliminary experiments on seedlings with a combined oil emulsion and stomach poison have given promising results. Incidentally, the spraying of the seed beds would help to control any early attacks of such leaf-eating pests as *Prodenia litura* and small grasshoppers.

Remedial Measures.—The tobacco stem-borer can be controlled to a great extent by a combination of various cultural and mechanical operations, among which may be mentioned the following: (1) the growing of vigorous seedlings by careful preparation and management of the seed beds; (2) the weeding out and burning of borer-infested seedlings; the careful transplanting of borer-free plants into suitable soil well-manured so as to encourage a vigorous growth from the start; (3) the periodical removal of any sickly plants and the substitution of vigorous supplies; (4) the cutting back of older borer-infested plants to collar level with the object of getting these plants to produce one vigorous new shoot each; (5) slitting the swollen stems with a sharp, slender knife and killing the larvae and pupae inside; (6) the growing of the crop in regular rotation with other suitable crops; and (7) the removal and burning of the crop refuse as soon as possible after harvest. Measure No. 5 has been employed in India with satisfactory results and is worthy of trial locally.

If all the above suggested remedial measures were to be carried out, where necessary, in conjunction with any approved preventive measures as routine practices on tobacco stations and in village areas, the tobacco stem-borer would be reduced to a negligible quantity. In any given district only one crop of tobacco should be grown annually, and if all the plants, including any wild tobacco, are destroyed at the end of the main harvest, there would be a definite close season during which the pest would be deprived of any really satisfactory breeding places and would find it difficult to carry on from one season to another, as it is able to do in some districts at present. In the event of the discovery of any alternate host plants of this pest, measures would have to be taken to eliminate these as far as possible from the district concerned.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED 30 JUNE, 1934

Province, &c.	Disease	No. of Cases up to Date since Jan. 1st 1933	Fresh Cases	Recoveries	Deaths	Balance Ill	No. Shot
Western	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	399	197	321	...	78	...
	Anthrax	...	...	...	...	..	...
	Rabies (Dogs)	11	2	...	...	...	11
	Piroplasmosis	...	...	...	...	...	...
Colombo Municipality	Rinderpest	..	...	...	...	...	...
	Foot-and-mouth disease	551	72	513	20	18	...
	Anthrax	3	...	...	3	...	...
	Rabies (Dogs)	2	...	...	...	...	2
	Haemorrhagic Septicaemia	...	...	...	...	...	...
	Black Quarter	...	...	...	...	...	...
	Bovine Tuberculosis	...	...	...	...	...	...
Cattle Quarantine Station	Rinderpest	.	...	...	...	...	...
	Foot-and-mouth disease	11	...	10	1	...	...
	Anthrax (Sheep & Goats)	115	30	...	115	...	...
Central	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	15	2	15	...	...	...
	Anthrax	...	...	...	...	.	...
	Bovine Tuberculosis	3	...	..	...	3	...
	Rabies (Dogs)	...	...	.	...	...	...
Southern	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	159	...	159	...	...	...
	Anthrax	...	...	...	...	...	...
	Rabies (Dogs)	...	...	..	...	...	...
Northern	Rinderpest	144	...	43	93	...	8
	Foot-and-mouth disease	28	...	28	...	...	...
	Anthrax	...	...	...	...	...	...
	Black Quarter	..	...	...	...	...	...
	Rabies (Dogs)	..	...	...	...	...	...
Eastern	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	114*	8	102	...	12	...
	Anthrax	...	...	...	...	...	...
North-Western	Rinderpest	...	...	...	...	—	...
	Foot-and-mouth disease	...	...	...	...	...	...
	Anthrax	...	...	..	...	...	...
	Rabies (Dogs)	9	7†	...	7	...	2
	Piroplasmosis	1	...	...	1	..	...
North-Central	Rinderpest	63	...	13	44	...	6
	Foot-and-mouth disease	..	...	...	...	...	...
	Anthrax	...	...	...		...	...
Uva	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	213	...	207	6	...	...
	Anthrax	...	...	...	..	...	...
	Bovine Tuberculosis	...	...	...	...	...	...
Sabaragamuwa	Rinderpest	..	...	...	...	...	...
	Foot-and-mouth disease	233	...	233	...	...	...
	Anthrax	...	...	...	...	...	...
	Piroplasmosis	...	...	...	...	...	...
	Haemorrhagic Septicaemia	14	2	...	14	...	...
	Rabies (Dogs)	4	...	...	...	...	4

* 84 cases occurred during May, 1934. † 1 case, a Calf.

G. V. S. Office.
Colombo, 10th July, 1934.

M. CRAWFORD,
Government Veterinary Surgeon

METEOROLOGICAL REPORT,

JUNE, 1934

Station	Temperature				Humidity		Amount of Cloud	Rainfall		
	Mean Maximum	Difference from Average	Mean Minimum	Difference from Average	Day	Night (from Minimum)		Amount	No. of Rainy Days	Difference from Average
	°	°	°	°	%	%		Inches		Inches
Colombo -	84·5	−0·8	76·4	−0·8	82	88	8·6	18·22	21	+ 9·84
Puttalam -	86·4	+0·6	79·0	−0·2	76	85	7·0	1·21	7	− 0·43
Mannar -	88·1	−0·7	80·4	−0·1	75	82	6·8	0·59	3	+ 0·08
Jaffna -	86·8	+0·5	80·9	+0·3	79	80	5·3	0·99	3	+ 0·38
Trincomalee -	91·4	+0·1	78·3	−0·3	64	80	6·8	0·71	3	− 0·48
Batticaloa -	91·7	−0·5	77·5	+0·5	62	82	7·5	0·71	4	− 0·24
Hambantota -	87·1	+1·1	76·6	−0·1	72	86	5·8	1·67	11	− 0·70
Galle -	82·9	−0·9	76·1	−0·8	86	91	6·8	17·17	25	+ 8·87
Ratnapura -	85·9	−0·4	73·8	−0·7	80	95	8·2	29·42	24	+ 9·64
A'pura -	90·1	+1·6	76·1	−0·1	67	91	8·4	0·70	3	− 0·52
Kurunegala -	86·8	+0·4	75·2	−0·3	74	88	8·7	7·61	19	− 0·11
Kandy -	83·4	+0·7	70·8	−0·2	76	87	8·2	9·86	21	+ 0·50
Badulla -	84·2	−1·0	65·9	+0·6	68	95	6·6	1·73	7	− 0·42
Diyatalawa -	76·6	−1·4	63·9	+1·1	66	79	7·6	4·74	11	+ 2·84
Hakgala -	69·0	+0·4	57·8	+0·1	81	83	7·1	8·17	22	+ 0·52
N'Eliya -	66·6	+0·7	55·0	−0·4	85	91	8·8	12·65	24	+ 0·16

The rainfall of June was appreciably above normal in the south-western low-country, on the whole a little above normal in the hills, and elsewhere below normal. Several stations, particularly in the districts north of Anuradhapura, reported no rain at all during the month. As was the case last month, excess was most marked in the districts along and near the south-west coast.

The highest monthly total was 45·08 inches, at Kenilworth estate, while other stations reporting over 40 inches were Blackwater estate, Watawala, Norton Bridge estate, and Geekiyanakanda estate.

28 daily falls of 5 inches or over were reported during the month, from 22 stations. These were mainly on the 2nd, 6th, and 7th. The highest daily falls reported were 10·75 inches, at Geekiyanakanda, on the 7th, and 10·30 inches, at Maggona, on the 6th.

The monsoon, which appeared towards the end of May, weakened during the first few days of June. From the 6th to the 14th, there was fairly heavy monsoonal rain in the south-west of the Island. In the second half of the month, the monsoonal rainfall was generally light, with the exception of two short spells of moderately heavy rain, from the 17th to the 20th, and from the 24th to the 27th.

Temperatures showed no marked deviations from normal. Humidity was, on the whole, a little above normal, while cloud was also above normal.

Barometric pressure was above normal, while the wind, which was generally S.W. or W.S.W., was below normal strength at most stations.

A hailstorm was reported on the 6th, from both Diyatalawa and Bandarawela.

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